CRITICAL AREAS REPORT AND DETAILED MITIGATION PLAN

BUILDING X PROJECT
REDMOND, WASHINGTON

Prepared For:

Willow Run, LLC
Wilmington, Delaware

Prepared By:

TALASAEA CONSULTANTS, INC.
Woodinville, Washington

6 February 2019
(Revised 18 October 2019)

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Prepared For:

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251 Little Falls Dr.
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Prepared By:

Talasaea Consultants, Inc.
15020 Bear Creek Road NE
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EXECUTIVE SUMMARY

PROJECT NAME: Building X Project

CLIENT: Rory O'Brien, Willow Run, LLC

251 Little Falls Drive, Wilmington, Delaware.
(650) 313-4821

SITE LOCATION: The Building X Site is an approximately 8.9-acre parcel located at 10301 Willows Road NE, Redmond, Washington. The tax parcel number of the property is 3426059037. The Public Land Survey System (PLSS) location of the Property is the SW ¼ of the SE ¼ Section 34, Township 26N, Range 5E, W.M. (See **Figure 1**)

CONSULTANT: Talasaea Consultants, Inc.

15020 Bear Creek Road NE, Woodinville, Washington.
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PROJECT STAFF: Bill Shiels, Principal; Ann Olsen, RLA, Senior Project Manager; Jennifer Marriott, Senior Ecologist; David R. Teesdale, PWS, Senior Wetland Ecologist; Kellen Maloney, Ecologist.

FIELD SURVEY: Site evaluations and critical area delineations were performed on 12 and 22 June 2018, 3 January 2019.

CRITICAL AREAS DETERMINATION: One wetland, called Wetland A, was identified in the northwest corner of the property, and two streams, called Stream 1 and Stream 2, are located on the western half of the property. Wetland A (approximately 1,936 sf) is a Category IV palustrine scrub-shrub slope wetland with a 50-foot standard buffer consistent with Redmond Zoning Code (RZC) Title 21 Zoning Code §21.64.020.B.2. Streams 1 and, 2 are rated as intermittent Class IV streams with 25-foot standard buffers, consistent with RZC §21.64.020.A.2. Stream 1 flows onto the property near the property's northwestern corner and flows in an easterly direction. The stream remains aboveground for approximately 650 feet before infiltrating on all but the highest seasonal flow rates. Streamflow that does reach Willows Road NE enters the road's stormwater system at the property's northeastern corner. Stream 2 does not flow onto the subject property, nor does its standard buffer project over the subject property's boundaries.

HABITAT ASSESSMENT: The majority of the subject property is developed with one commercial office building (37,408 sf) and associated infrastructure (drive aisles, parking) surrounded by maintained lawn and landscaping (approximately 121,115 sf of paved surface and 245,928 sf of open space for a total of approximately 388,220 sf). The western edge of the subject property is forested, contains one wetland (Wetland A), one stream (Stream 1), and is contiguous with a large wildlife corridor west of the Site. The subject property contains significant areas of Himalayan blackberry within its undeveloped portion.

We evaluated the habitat potential of the site against the City of Redmond's list of species of local importance. The only species listed, the great blue heron, was determined to have a low likelihood of being present on the Site. No State- or Federally-listed species or State-listed priority habitats were identified on Site.

VEGETATION: The eastern portion of the subject property is maintained as mowed lawn with landscaping islands that contain native and ornamental plant species. The western boundary of the subject property is undeveloped and vegetated with a mixed deciduous-coniferous forest and patches of non-native, invasive plant species. Typical upland vegetation includes Douglas fir, western redcedar, big-leaf maple, black cottonwood, red alder, Indian plum, vine maple, and sword fern.

SOILS: The Natural Resources Conservation Service has mapped two soil types on the subject property. These soils are Alderwood gravelly sandy loam, 8-15% slopes, and Indianola loamy sand, 0-5% slopes. These soils are not considered to be hydric by the National Technical Committee on Hydric Soils. Slopes and geological characteristics were not included in this report.

HYDROLOGY: Hydrology for Stream 1 is supported primarily by shallow groundwater from a ravine located offsite to the west of the stream. Wetland A is supported by shallow groundwater seepage along a slope gradient. No stream flows into or out of Wetland A.

PROPOSED PROJECT: The Building X Project includes the construction of an approximately 339,010 square foot (gross square footage) office and research/development building that will include offices, labs, food services for employees, event spaces, and outdoor landscaped roof terraces to support the Facebook Reality Lab business unit. Approximately 98,554 sf will be paved, and 155,331 sf will be maintained as open space. Multi-tiered parking, located partially above grade, will accommodate approximately 794 cars. The proposed design of the building and parking will efficiently use space on the sloped property while minimizing disturbance to existing trees.

PROJECT IMPACTS: In order to accommodate emergency vehicles around the new building, the access road adjacent to the northwest corner of the proposed Building X will need to curve outward to the west. This will result in impacting a portion of Stream 1 that is currently partially piped under the existing drive aisles and open channel, and encroaching to within 10 feet of Wetland A. Approximately 195 linear feet of open channel will be filled, and 70 linear feet of existing culverted stream will be moved. Total stream impacts are approximately 254 linear feet. Approximately 468 sf of wetland will be converted to buffer to provide the reduced 37.5-foot Category IV wetland buffer for Wetland A. This conversion uses the Washington Department of Ecology's concept of "wetland as buffer." No actual wetland fill will occur. There will be no other impacts to critical areas resulting from the proposed development.

It is proposed to construct a new stream channel west of the proposed extent of development to provide Stream 1 with greater than 25 feet of stream buffer. The new stream channel will discharge into the newly created buffer for Wetland A before being discharged into an extension of an existing culvert. This extended culvert is necessary to prevent erosion and downcutting of the new channel between Wetland A and an existing road providing access to the property to the north of the Site. The extended culvert will pass streamflow under this existing access road and discharge into the remaining Stream 1 channel. The remaining Stream 1 channel along the north property boundary extends eastward to Willows Road NE.

PROPOSED MITIGATION: Mitigation for the proposed impact to Stream 1 will involve the creation of a new Stream 1 channel, installation of large woody debris and other habitat features, and restoration and enhancement of the remaining stream buffer on the subject property. In addition, a corrugated metal culvert, which currently serves no purpose will be removed from the existing stream channel along the northern property boundary. A second culvert in this same channel reach will be retained and treated with an epoxy coating in order that a landmark tree can be saved. The total length of culvert removal will be 11 linear feet. The remaining on-site portion of stream buffer along the northern property boundary (approximately 7,643 sf) will be enhanced by removal of non-native, invasive species, including lawn, and replanting with a variety of native trees and shrubs.

Mitigation for the conversion of approximately 468 sf of wetland into buffer will be identified commensurate with the scope of the impacts. The impact will be partially offset by the creation of approximately 490 sf of new wetland (greater than 1;1 ratio) associated with Stream 1 and enhancement of approximately 1,469 sf of existing wetland (greater than 3:1 ratio).

Stream and wetland buffer areas disturbed during construction will be replanted with a variety of native trees and shrubs. Approximately 9,549 sf of buffer for Wetland A and Stream 1 in the Site's northwestern corner will be enhanced by the removal of non-native, invasive species such as Himalayan blackberry, and selectively planted with native conifer trees to improve species and structural diversity that is currently lacking. The restoration and enhancement both in and adjacent to critical areas provide substantially better riparian and wetland habitat compared to existing conditions.

The proposed mitigation will be maintained and monitored twice a year for a minimum of five (5) years for the City of Redmond and ten (10) years in satisfaction of Army Corps of Engineers monitoring requirements.

The primary goal of the proposed mitigation plan is to substantially enhance the remaining portion of the on-site stream buffer to improve overall riparian corridor habitat functioning. To accomplish these goals, the proposed project will:

- Enhance and restore 7,643 sf of Stream 1 buffer along the north property line,
- Enhance and restore 15,953 sf of buffer for Wetland A and approximately 16,371 sf for the new Stream 1 channel,
- Enhance 1,936 sf of Wetland A (468 sf of wetland converted into buffer and 1,469 sf of remaining wetland),
  and
- Create approximately 490 sf of new wetland associated with Stream 1.

Mitigation actions will be evaluated through the following objectives and performance standards. See **Section 10.3** for a full description of the monitoring methods that will be used to evaluate the approved performance standards. Mitigation monitoring will be performed by a qualified biologist.

Objective A: Create structural and plant species diversity in the enhanced and restored stream and wetland buffers.

Performance Standard A1: At least 10 species of desirable native plants will be present in the mitigation areas during the monitoring period. Percent survival of planted woody species must be at least 100% at the end of Year 1 (per contactor warranty), and at least 80% for each subsequent year of the monitoring period.

Performance Standard A2: Total percent aerial woody plant coverage must be at least 35% by Year 4 and 50% by Year 5. Woody coverage may be comprised of both planted and recolonized native species; however, to maintain species diversity, at no time shall a recolonized species (e.g., red alder) comprise more than 35% of the total woody coverage. There must be at least three native species providing at least 20% each, or four native species providing at least 15% each, or five native species providing at least 10% of the total aerial woody plant coverage.

Objective B: Create habitat structure and plant species diversity in the created wetland, and wetland enhancement areas.

Performance Standard B1: At least 2 species of desirable native plants will be present in the created wetland during each year of the monitoring period.

Performance Standard B2: Percent survival of all planted woody species must be at least 100% at the end of Year 1 (per contractor warranty), and at least 80% for each subsequent year of the monitoring period.

Performance Standard B3: Created Emergent Wetland: Coverage of herbaceous vegetation shall be at least 30% by the end of Year 1, 50% by the end of Year 2, and 65% by the end of Year 5, excluding those areas of the site that may have sparse herbaceous vegetation due to dense shade from woody species coverage.

Objective C: Created wetland must exhibit wetland hydrology.

Performance Standard C1: Wetland Hydrology: After construction, the created wetland areas shall exhibit 14 or more consecutive days of hydrology during the growing season in each year of normal rainfall (based on a normal precipitation analysis). Evidence of wetland hydrology may include evidence of saturated soil conditions (i.e., signs of ponding, a water table near the surface, watermarks, water-stained leaves, or oxidized rhizospheres). In addition, a combination of native or naturalized woody and herbaceous vegetation that is predominantly FAC or wetter will cover the wetland areas. Hydrology shall be monitored annually concurrent with either spring or fall monitoring events.

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Chapter 1. INTRODUCTION

1.1 Report Purpose

This report is the result of a critical areas study of the Building X Project property located at 10301 Willows Road NE (referred to as "Site" hereinafter) in Redmond, Washington (**Figure 1**). The purpose of this report is to identify, describe, and categorize critical areas located on or adjacent to the Site, describe the proposed redevelopment of the property and potential impacts to critical areas resulting from redevelopment, and propose a detailed mitigation plan to offset impacts to critical areas.

This report has been prepared to comply with the reporting requirements of the Redmond Zoning Code (RZC) Title 21 Zoning and Appendix 1: Critical Areas Reporting Requirements. Specifically, this report provides the following information:

- Property Overview;
- Methodology for Critical Areas Investigations;
- Review and Evaluation of Existing Resource Information;
- Review and Evaluation of On-Site Critical Areas and Habitats;
- Analysis of Critical Area Regulations;
- Proposed Site Redevelopment;
- Assessment of Critical Areas Impacts;
- Proposed Detailed Mitigation Plan;
- Construction Sequencing;
- Performance Monitoring, Maintenance and Contingency Plan; and
- Summary.

1.2 Statement of Accuracy

The critical area study and regulatory review were conducted by trained professionals of Talasaea Consultants, Inc., in adherence to the protocols, guidelines, and generally accepted industry standards available at the time work was performed. The conclusions in this report are based on the results of analyses performed by Talasaea Consultants and represent our best professional judgment. To that extent, and within the limitations of project scope and budget, we believe the information provided herein is accurate and true to the best of our knowledge. Talasaea Consultants does not warrant any assumptions or conclusions not expressly made in this report or based on information or analyses other than what is included herein.

1.3 Qualifications

Field investigations and evaluations were conducted by Talasaea staff, including: Bill Shiels, Principal; Ann Olsen – RLA, Senior Project Manager; David R. Teesdale - PWS, Senior Wetland Ecologist; Jennifer Marriott - PWS, Senior Ecologist; and Kellen Maloney, Ecologist. Bill Shiels has a Bachelor's Degree in Biology from Central Washington University and a Master's Degree in Biological Oceanography from the University of Alaska. He has over 40 years of experience in wetland delineations and mitigations. Ann Olsen has a BLA in Landscape Architecture from the University of Washington (1993). She has over 25 years of experience in environmental planning, restoration, mitigation and landscape design, project management and administration,

and construction management. David Teesdale has a Bachelor's Degree in Biology from Grinnell College, Iowa, and a Master's Degree in Ecology from Illinois State University. He has 20 years of experience in wetland delineations and biological evaluations. Jennifer Marriott has a Bachelor's Degree and a Master's Degree in Biology from the University of Central Florida, and a second Master's Degree in Soil and Environmental Science from the University of Florida. She has over 13 years of experience in wetland delineations and environmental permitting. Kellen Maloney has a Bachelor's Degree in Environmental Science from the University of Washington and two years of experience in wetland delineations.

Chapter 2. PROPERTY OVERVIEW

2.1 Project Location

The Site is an approximately 8.9-acre parcel located off Willows Road NE in the City of Redmond, Washington (**Figure 2**). The tax parcel number of the Site is 3426059037. The Public Land Survey System (PLSS) location of the Site is the SW ¼ of the SE ¼ Section 34, Township 26N, Range 5E, W.M.

The Site is bordered on the east side by Willows Road NE, to the north and south by other commercial building lots, and to the west by undeveloped, forested lots. Access to the Site is provided by a driveway off Willows Road NE.

2.1.1 General Property Description

The Site is currently developed with one building and associated access road, parking, and other infrastructure (**Figure 2**). The eastern portion of the Site is developed as a corporate campus with a single commercial building (approximately 37,408 sf), with approximately 121,115 sf of paved surfaces and approximately 245,928 sf of open space (total area of approximately 388,220 sf). The Site (based on its original configuration) also contained approximately 2.8 acres of pavement. The remainder of the Site is maintained as mowed lawn with landscaping islands that contain native and ornamental species. The western boundary of the Site is undeveloped and vegetated with a mixed deciduous-coniferous forest. Patches of non-native, invasive Himalayan blackberry exist northwest of the Site. Approximately 5.6 acres is maintained as undeveloped land or landscaped open space. Site topography is generally sloped between 8 and 20 percent to the east.

The Site's boundaries are to be revised through a Boundary Line Adjustment (BLA) along the parcel's southern border. The Sites' southwest and southeast corners were moved 16 feet and 207 feet respectively. The area of the Site is now approximately 8.9 acres; an increase of approximately 1.83 acres.

2.1.2 Historical Land Use

Prior to 1936 and until the 1980s, the Site appears to have been cleared of vegetation and used primarily as a single-family residence with associated farming and pasture areas. The Site was redeveloped with a commercial office building in the 1990s and has not changed use since that time.

Chapter 3. METHODOLOGY

The critical areas analysis of the Site involved a two-part effort. The first part consisted of a preliminary assessment of the Site and the immediate surrounding area using published environmental information. This information included:

1) Wetland, soils, and wildlife information from resource agencies;
2) Critical areas information from the City of Redmond and King County;
3) Anadromous fish presence information from:
4) StreamNet database
5) SalmonScape database
6) GIS analysis of orthophotography, and
7) LIDAR data.

The second part consisted of site investigations where direct observations of existing environmental conditions were made. Plant communities, soils, hydrology, stream, and wildlife habitat conditions were observed. This information was used to help characterize the existing conditions of the property, and to identify and delineate critical areas (see **Section 3.2 – Field Investigation**, below)

3.1 Background Data Reviewed

Background information from the following sources was used prior to our field investigations:

- US Fish and Wildlife Service (USFWS), Wetlands Online Mapper (National Wetlands Inventory, NWI) (USFWS 2018) (www.wetlandsfws.er.usgs.gov/wtlnds/launch.html);
- Natural Resources Conservation Service (NRCS), Web Soil Survey (NRCS 2018) (www.websoilsurvey.nrcs.usda.gov/app/);
- NRCS, National Hydric Soils List by State (NRCS 2018) (www.soils.usda.gov/use/hydric/lists/state.html);
- City of Redmond GIS databases (City of Redmond, 2018);
- King County GIS databases (King County, 2018);
- StreamNet database, 2018 (www.streamnet.org);
- SalmonScape database, 2018 (www.wdfw.wa.gov/mapping/salmonscape/databases);
- Washington State Department of Fish and Wildlife (WDFW) Priority Habitats and Species (PHS) Database on the Web (WDFW 2018) (http://wdfw.wa.gov/mapping/phs/);
- Washington Department of Natural Resources (WDNR) Natural Heritage Database;
- Orthophotography from USDA's National Agricultural Imagery Program (NAIP 2018) and Google Earth; and
- LIDAR information from the Puget Sound LIDAR Consortium and King County (pugetsoundlidar.ess.washington.edu), and WDNR LIDAR Portal (http://lidarportal.dnr.wa.gov/#47.85095:-122.24470:14).

3.2 Field Investigation

The Site was evaluated by Talasaea Consultants, Inc. on 12 and 22 June 2018, and again on 3 January 2019 for the presence of critical areas, including wetlands and streams, as well as wildlife habitat. One stream and one wetland were identified on the Site. The stream's ordinary high water marks were delineated and flagged during the 12 June 2018 site visit. The wetland was delineated on 3 January 2019.

Wetlands were identified and characterized using the U.S. Army Corps of Engineers *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region* (24 June 2010), per RZC Title 21 Zoning §21.78.W Wetland Delineation Manual. Wetlands were rated using the Washington Department of Ecology's *Washington State Wetland Rating System for Western Washington* (October 2014), per RZC Title §21.64.030.A.1. Wetland rating forms are provided in **Appendix C**.

The ordinary high water marks for streams were determined using the general methodology as described in *Determining the Ordinary High Water Mark for Shoreline Management Act Compliance in Washington State* (Anderson *et al*. 2016). Physical barriers to fish migration and typing of on-site streams were determined using the water typing criteria provided under WAC 222-16-030. Streams were characterized and rated using the guidance provided under RZC Title §21.64.020.A.2.d.

Plant species were identified according to the taxonomy of Hitchcock and Cronquist (Hitchcock and Cronquist 2018). Taxonomic names were updated, and plant wetland status assigned according to the *North American Digital Flora: National Wetland Plant List, Version 2.4.0* (Lichvar 2012). Wetland classes were determined with the U.S. Fish and Wildlife Service's system of wetland classification (Cowardin, *et al.* 1979). Vegetation was considered hydrophytic if greater than 50% of the dominant plant species had a wetland indicator status of facultative or wetter (i.e., facultative, facultative wetland, or obligate wetland).

Wetland hydrology was determined based on the presence of hydrologic indicators listed in the Corps' Regional Supplement. These indicators are separated into Primary Indicators and Secondary Indicators. To confirm the presence of wetland hydrology, one Primary Indicator or two Secondary Indicators must be demonstrated. Indicators of wetland hydrology may include, but are not necessarily limited to: drainage patterns, drift lines, sediment deposition, watermarks, stream gauge data and flood predictions, historical records, visual observation of saturated soils, and visual observation of inundation.

Soils were considered hydric if one or more of the hydric indicators listed in the Corps' Regional Supplement were present. Indicators include the presence of organic soils, reduced, depleted, or gleyed soils, or redoximorphic features in association with reduced soils.

An evaluation of patterns of vegetation, soil, and hydrology was made in the wettest suspect areas of the Site. Sample points were flagged for later survey. **Appendix B**

contains data forms prepared by Talasaea for representative locations in these areas of the Site. These data forms document the vegetation, soil, and hydrology information that aided in the wetland boundary determination.

Chapter 4. RESULTS

4.1 Analysis of Resource Information

This section describes the results of our research and field investigations. For the purposes of this report, the term "vicinity" shall mean an area within ½ mile of the Site.

4.1.1 National Wetland Inventory

The National Wetland Inventory for the Kirkland quadrangle maps one wetland (a palustrine emergent, seasonally flooded wetland, (PEM1C) approximately 240 feet east of the Site. A riverine system (R4SCB) is also mapped as flowing along the northern boundary of the Site (**Figure 3**). This riverine system is described as intermittently flowing and seasonally flooded.

4.1.2 Natural Resources Conservation Service

The Natural Resources Conservation Service maps two soil types on the Site (**Figure 4**). These are Alderwood gravelly sandy loam 8-15% slopes and Indianola loamy sand 0-5% slopes. The Alderwood soil series comprises almost the entire Site, and the Indianola soil series is mapped only along the eastern boundary of the Site. Soils within the Alderwood and Indianola series are generally considered to be non-hydric, but may contain associated hydric soils (as determined by the National Technical Committee on Hydric Soils) within the map unit that comprise a significant fraction of the soil unit's mapped area.

4.1.3 City of Redmond Critical Areas Maps

The City of Redmond GIS database maps one stream entering the northwest portion of Parcel A from the west, one stream adjacent to the northwest portion of Parcel A on the neighboring property, and one stream stopping at the west property boundary of Parcel B. The stream mapped flowing onto Parcel A enters from the west near the northwestern portion of Parcel A (**Figure 5**) but is depicted as ending at the drive aisle to the property located to the north. This stream is generally analogous with the northern feature mapped by King County and WDFW, as well as Stream 1 that was delineated by Talasaea. The feature mapped stopping at Parcel B is analogous with the southern stream mapped by King County and was not consistent with any critical areas identified on Site. The City of Redmond GIS stream layer was created from LiDAR data and may not have been field verified. Other features mapped are stormwater retention ponds built for the existing development.

4.1.4 King County Critical Areas Map

King County GIS maps two streams on the Site. One stream is mapped flowing onto the site from the west at the northern boundary of Parcel A. It flows in an easterly direction along the northern boundary of the Site before ending near the eastern boundary of Parcel A. This feature is consistent with the NWI mapped stream and Stream 1 identified during the 12 June 2018 field investigation. Another stream is

mapped flowing onto the site south of Stream 1 near the northwest corner of Parcel B. It is shown flowing in an easterly direction and is mapped ending approximately five feet after entering Parcel B. This feature is not consistent with any critical areas identified on Site. Critical areas mapped by agencies do not always reflect field conditions.

4.1.5 WDFW Priority Habitats and Species Database

We reviewed WDFW's Priority Habitats and Species online mapping program to determine if any priority habitats or species are mapped on or adjacent to the Site. No priority habitats or species are identified on the Site. The Willows Run golf course, which is east of the Site, is mapped as a wetland.

4.1.6 WDNR Natural Heritage Database

We reviewed the latest GIS database available from the WDNR Natural Heritage Database for rare or endangered species or habitats. While the WDFW PHS program focuses on animal species and their essential habitats, the WDNR Natural Heritage Database focuses on sensitive, rare, or endangered plant species or assemblages. The database does not indicate any sensitive, rare, or endangered plants or plant assemblages on the Site.

4.2 Analysis of Existing Site Conditions

Talasaea Consultants identified one stream and one wetland on the Site (**Sheets W1.0** through **W1.1, Appendix A**). The ordinary high water mark (OHWM) of the stream was delineated and marked in the field with orange wire flags. The stream was labeled as Stream 1. A series of photos documenting existing stream and buffer conditions are included as **Appendix E**. A stormwater conveyance ditch was located along the south side of the parking lot on Parcel B. The ditch is V-shaped and lined with riprap. It conveys stormwater runoff to a detention pond located along Willows Road NE. No other critical areas were mapped on or near the Site.

4.2.1 Historical Perspective

The Site had been significantly altered to construct a single-family residence prior to 1936 and until the 1990s when the Site was redeveloped with commercial buildings. The northern portion of the Site containing Stream 1 and Wetland A appear to have been logged prior to 1936, with significant areas of grading and impact along both banks of the stream.

4.2.2 Wetland A

Wetland A is a relatively small (approximately 1,936 sf) slope wetland located near the Site's northwest corner (**Sheet W1.0, Appendix A**). The wetland resides within a small drainage basin. Vegetation within the wetland consists predominantly of black cottonwood, red alder, salmonberry, and Himalayan blackberry, with the scrub-shrub vegetation dominant over the tree vegetation (palustrine scrub-shrub). Upland vegetation is similar but includes sword fern, beaked hazelnut, and others.

The wetland generally does not provide significant water quality or flood prevention functions due to its location in the landscape (no development upgradient of the

wetland), relatively small size, and a lack of features that would retain flows (i.e., micro-depressions, large woody debris, etc.).

The soil within Wetland A is gravelly sandy loam and is generally black, very dark brown to dark grayish brown with dark yellowish-brown redoximorphic features.

Wetland A was rated using the Washington State Department of Ecology's *Washington State Wetland Rating System for Western Washington* (2014). The wetland scored 5 points for Improving Water Quality, 4 points for Hydrology, and 5 points for Habitat functions. The Total Score of Functions is 14, which satisfies the criteria for classification as a Category IV wetland. Category IV wetlands in the City of Redmond have a 50-foot standard buffer associated with them measured landward from the wetland's delineated boundary.

4.2.3 Stream 1

Stream 1 enters the Site at its northwest corner and continues flowing in a north-easterly direction at a relatively steep gradient (**Sheet W1.0, Appendix A**). The stream flows along the existing edge of parking and flows through two existing culverts until it reaches the northern boundary of the Site. The stream continues eastward along the existing edge of the northern access road. It flows through two additional culverts along this stretch before discharging into a culvert at Willows Road NE. A City of Redmond Stream Summary Sheet is included in **Appendix F** of this report. We observed that Stream 1 appears to infiltrate approximately 150 feet west of Willows Road NE in all but the highest flow rates. The lack of leaf litter and other vegetation within the stream channel from the point of infiltration to Willows Road NE suggests that water can and does seasonally flow the entire length of its channel across the northern boundary of the Site. Stream 1 is an intermittently flowing stream that drains a small basin (approximately 8.99 acres) situated in the forested hillside west of the Site. The stream may receive most of its water from stormwater discharge off of NE 103rd Street, which is approximately 1,030 feet west of the Site. A steep gradient and intermittent flow pattern prevent Stream 1 from supporting resident and anadromous fish populations.

The City of Redmond GIS database gives this stream a Class IV rating. Class IV streams are defined by RZC Title §21.64.020.A.2.d.iv as perennial or intermittent non-headwater streams that do not have fish or the potential to support fish and are non-headwater streams. Class IV waters with intermittent flow in the City of Redmond have a 25-foot standard buffer measured from the OHWM (RZC Title §21.64.020). Buffer widths for streams within the City of Redmond are based on water typing and flow regime. Buffers are measured landward from the OHWM (RZC Title §21.64.020.B.2). The stream was classified in accordance with the water typing rules contained in the Washington Administrative Code (WAC) 222-16-030.

The buffer on the south side of Stream 1 overlaps with paved areas that serve as the existing Site access. The buffer along the north property line of Stream 1 is mostly mowed lawn with existing large trees. Portions of this buffer are currently managed as landscaping by the adjacent property north of the Site.

4.2.4 Existing Patterns of Buffer Disturbance

The areas of disturbance include the paved southern half of the Stream 1 buffer and the maintained landscaping on the northern half. Vegetation within the area of disturbance consists predominantly of maintained native landscape species, including Douglas fir (*Pseudotsuga menziesii*) and paper birch (*Betula papyrifera*). Mowing likely occurs at least once a year.

There are currently no restrictions (by fence or vegetation) preventing people or pets from accessing the impacted buffer area. Dr. Thomas Hruby (Washington Department of Ecology, retired) noted in his wetland rating documents (Hruby 2014) that intrusion into buffers by people or pets creates significant stress on wildlife that is present. The potential for disturbance by people, pets, and machinery significantly reduces the ability of the standard 25-foot buffer to provide habitat for many species of wildlife.

4.2.5 Stream 2

A second seasonal drainage (identified as Stream 2) exists approximately 37 feet south of the Site's southwest property corner (**Sheet W1.1, Appendix A**). Stream 2 is identified by the City of Redmond as a Class IV stream. Class IV streams have a 25-foot standard buffer associated with them. Neither Stream 2 nor its buffer extends onto the Site.

4.3 Upland Areas

Forested upland areas extend approximately 700 feet west of the Site. Typical vegetation within these areas includes big-leaf maple (*Acer macrophyllum*), Douglas fir, western redcedar (*Thuja plicata*), vine maple (*Acer circinatum*), sword fern (*Polystichum munitum*), trailing blackberry (*Rubus ursinus*), and salmonberry (*Rubus spectabilis*). Himalayan blackberry (*Rubus armeniacus*) *is* present in the northwestern area of the Site, west of Stream 1. These upland areas can provide important regional habitat value as a wildlife corridor in their existing state.

Chapter 5. FISH AND WILDLIFE HABITAT CONSERVATION AREAS ASSESSMENT

In accordance with RZC Title §21.64.020.A.2, fish and wildlife habitat conservation areas on the Site were rated according to their characteristics, function, value, or their sensitivity to disturbance.

5.1 Fish and Wildlife Habitat Relationships

The habitat components identified on the Site were assessed for existing or potential habitat for Species of Concern and Species of Local Importance per RZC Title §21.64.020. The species list was generated from the habitat-wildlife associations defined by *Wildlife Habitat Relationships in Oregon and Washington* (Johnson and O'Neil 2001), the WDFW listing of Species of Concern in Washington State, and the City of Redmond designation of Species of Local Importance. The WDFW Species of Concern list includes those species listed as State Endangered, State Threatened, State Sensitive, or State Candidate, as well as species listed or proposed for listing by

the U.S. Fish and Wildlife Service or the National Marine Fisheries Service[1]. **Table 1** summarizes Species of Concern and Species of Local Importance and indicates primary association habitats for each within the project area. **Appendix E** contains the City of Redmond Habitat Unit Assessment Forms.

Table 1. Habitat Wildlife Associations

Species	Status[2]	Likelihood of Presence within Project Area
Great Blue Heron[3]	Species of Local Importance	**Low** – We observed no aquatic macroinvertebrates or amphibian larvae in the storm ponds located on the parcel to the south of the Site. Therefore, we believe that the Site does not contain habitat suitable for foraging by great blue heron. No rookeries were observed on site.
Bald Eagle	FCo	**Moderate** – Bald eagles feed on salmon, small to medium mammals, and carrion. Perching habitat on Site is a possibility as Bald Eagles are regularly seen along the Sammamish River.
Vaux's Swift	SC	**Low** – Vaux's swifts need large hollow trees or snags, or chimneys for nesting and roosting. They are not likely present in the project area due to a lack of suitable nesting and roosting habitat.
Pileated Woodpecker	SC	**Moderate** – Pileated woodpeckers need mature or maturing forests with a significant amount of dead or dying trees. The west and south areas of the Site provide such habitat. However, the Site provides little to no habitat for pileated woodpeckers
Purple Martin	SC	**Low** – Purple martins require nesting boxes or hollow trees. Purple martins are under considerable stress competing with European starlings for suitable nesting sites.
Townsend's Big-eared Bat	SC	**Low** – Townsend's big-eared bat can forage in almost any habitat, preferring upland habitats to open water. Coniferous woodlands are the primary roosting habitat for this species. The west and south areas of the Site may provide suitable roosting habitat.

5.2 Habitat Assessment

The Site was evaluated for the presence of listed fish and wildlife habitat. No listed species or priority habitats were identified during the 12 and 22 June 2018, and 3 January 2019 field investigations.

The Site was also evaluated for non-listed-species habitat. This habitat includes the edge between the developed areas of the Site and the undisturbed native vegetation west and south of the Site. These areas provide habitat for bird species, including the American robin (*Turdus migratorius*), black-capped chickadee (*Poecile atricapillus*), spotted towhee (*Pipilo maculatus*), Bewick's wren (*Thryomanes bewickii*), American crow (*Corvus brachyrhynchos*), kinglets (*Regulus spp.*), house sparrow (*Passer domesticus*), and European starling (*Sturnus vulgaris*). Mammal species, including, black-tailed deer (*Odocoileus hemionus)*, opossum (*Didelphis virginiana*), coyote (*Canis*

[1] http://wdfw.wa.gov/wlm/diversty/soc/soc.htm
[2] FE = Federal Endangered Species; FT = Federal Threatened Species; FC = Federal Candidate Species; FCo = Federal Species of Concern; SE = State Endangered Species; ST = State Threatened Species; SC = State Candidate Species; SS = State Sensitive Species
[3] Species of Local Importance, not Federally- or State-listed.

latrans), raccoon (*Procyon lotor*), eastern gray squirrel (*Sciurus carolinensis*), mountain beaver (*Aplodontia rufa*), and other mammal species adapted to urbanized environments may also utilize this habitat.

Quality habitat areas are defined by RZC Title §21.64.020.2.c based on their size, community diversity, interspersion, continuity, forest vegetation layers, forest age, and invasive plant coverage. Based on these criteria, habitat quality on the Site is relatively poor. Community diversity and habitat interspersion on the Site is limited primarily to frequently maintained lawn and landscaped areas. The majority of the landscaped areas on Site contain non-native vegetation that may not function as suitable habitat; however, some large native conifer trees on Site will likely provide habitat for native bird species.

5.3 Habitat Units

The Site was separated into habitat units to characterize vegetation cover types, plant communities, and wildlife-habitat associations. The habitat units were classified according to *Wildlife-Habitat Relationships in Oregon and Washington* (Johnson and O'Neil. 2001). The only habitat unit present on the Site is Medium-density Urban and Mixed Environs.

The Medium-density Urban and Mixed Environs habitat designation is defined as a zone with 30-59% impervious surface coverage. The Site meets this criterion. Vegetation composition in the developed areas of the Site is typical of developed land within a medium density urban commercial landscape. Vegetation within the onsite developed area includes ornamental landscaping with patches of native trees. Vegetation within the undeveloped areas of the Site includes a mix of native and non-native species.

5.4 Existing Site Vegetation

Three dominant vegetation communities exist on the Site. These include mixed coniferous-deciduous forest, maintained lawn, and native landscaping around stormwater features (**Sheets W1.0** and **W1.1** of **Appendix A**, and **Appendix D**).

Mixed Coniferous-Deciduous Forest

The western edge of the Site is comprised of mixed coniferous-deciduous forest species, including Douglas fir, western redcedar, big-leaf maple, black cottonwood (*Populus balsamifera*), and shrub species, including salmonberry, Indian plum (*Oemleria cerasiformis*), and vine maple. All three vegetation strata are well established and relatively diverse.

Maintained Lawn

A large portion of the Site is regularly maintained lawn. This vegetation community provides little habitat for listed wildlife species.

Native Landscaping

There are several patches of maintained native landscape that contain mature Douglas fir and western redcedar. This vegetation likely provides habitat for some species, but is not likely to provide habitat for listed species.

5.5 Wildlife Survey

We conducted a wildlife survey of the Site during our investigation. The portion of the Site managed for landscaping lacked evidence of wildlife usage. We noted the presence of squirrel and several bird species during our investigation. Birds were identified by sight and by vocalizations. Bird species include American robin, black-capped chickadee, chestnut-backed chickadee, European starling, American crow, and spotted towhee.

Chapter 6. ANALYSIS OF CRITICAL AREAS REGULATIONS

6.1 City of Redmond

Critical areas on the Site are subject to the regulations of the Redmond Zoning Code (RZC) Title 21 (§21.64.020 and §21.64.030). Section A of both code sections contains standards and requirements for the protection of wetlands and streams respectively and defines permissible uses within environmentally sensitive areas. Section B of both code sections establishes buffer widths. Section C establishes allowable alterations of wetlands, and fish and wildlife habitat conservation areas. Section D of §21.64.020 establishes allowed alterations to riparian stream corridors. Section D of §21.64.030 outlines wetland mitigation performance and design standards. Section E establishes requirements for the alteration of fish and wildlife habitat conservation areas. Section F establishes riparian stream corridor performance standards, and Section G establishes fish and wildlife habitat conservation area performance standards (Sections E through G do not pertain to wetland regulations). Appendix 1 of RZC Title 21 provides the reporting requirements for Critical Areas Reports.

According to RCZ Title §21.64.020.B.10, “Businesses currently located in the stream buffers may continue to operate. A nonconforming use may be expanded provided the expansion does not create significant additional impacts to the stream buffers. Nonconforming structures may be maintained and repaired, and may be enlarged or expanded provided said enlargement does not extend the structure closer to the riparian stream corridor.” The existing pavement for the northern access road currently exists within the 25-foot buffer for Stream 1. The buffer for Wetland A is currently outside of existing development.

RZC Title §21.64.030.B.6 and 7 provides guidance on permitted alterations to wetland buffers. Section B.6 discusses methods for reducing buffer widths. Section B.7 discusses wetland buffer width averaging.

6.2 State and Federal Regulations

6.2.1 Washington State Regulations

Critical areas on the Site, such as wetlands and streams, are subject to regulation at the State level primarily by the following statutes:

- State Water Pollution Control Act (administered by DOE);
- Section 401 of the Federal Clean Water Act (administered by DOE);
- Hydraulic Code of Washington (administered by WDFW);
- Forest Practices Application (administered by WDNR).

DOE uses Section 401 State Water Quality Certification (WQC) as the primary mechanism for implementing the provisions of the State Water Pollution Control Act. Section 401 WQC is typically issued in conjunction with Section 404 permits from the US Army Corps of Engineers (Corps). Any impacts to streams would also be regulated under the Hydraulic Code of Washington as part of the Hydraulic Project Approval (HPA) permit process. Land clearing activities that remove more than 5,000 board-feet of timber is subject to a Forest Practices Application Review by WDNR (or by the local jurisdiction per agreements with WDNR).

6.2.2 Federal Regulations

Critical areas on the Site are also subject to Federal regulations under Section 404 of the Clean Water Act. The Corps is responsible for administering compliance with Section 404 via the issuance of Nationwide or Individual Permits for any fill or dredging activities within wetlands or streams. Work impacting waters of the United States (wetlands or streams satisfying the significant nexus test) on this property will likely require an NWP 39 – Commercial and Institutional Developments. NWP 39 allows for up to ½ acre of fill or no more than 300 linear feet (lf) of loss of stream bed. A Pre-Construction Notification (PCN) is required as a specific regional condition.

Chapter 7. PROPOSED SITE REDEVELOPMENT

7.1 Project Description

The Building X Project is a proposed new research and development facility that will include offices, labs, food services for employees, event spaces, and outdoor landscaped roof terraces to support the Facebook Reality Lab business unit (**Sheet W1.2, Appendix A**). The at-grade footprint of the proposed building will be approximately 3.08 acres in size (134,214 sf). Below-grade multi-tiered parking will accommodate approximately 794 cars with an additional eight stalls maintained onsite. The total gross square footage of the proposed building is 339,010 sf. The remaining 254,006 sf of the Site will remain as open space.

The proposed design of the building and parking will efficiently use space on the sloped property while minimizing disturbance to existing trees. Stormwater will be collected and treated onsite prior to release to the regional stormwater system along Willows Road NE. There are no known water quality issues involving the current site development. The proposed development will not substantially improve water quality over existing conditions at the Site.

7.2 Assessment of Development Impacts

In order to accommodate emergency vehicles around the new building, the access road adjacent to the northwest corner of the proposed Building X will need to curve outward to the west (**Sheet W1.2, Appendix A**). This will result in impacting a portion of Stream 1 that flows along the edge of the pavement and is currently partially piped under the existing drive aisles. The existing length of Stream 1 on the Site is approximately 749 lf.

The proposed road expansion in the Site's northwest corner will unavoidably encroach into the buffer of Wetland A. This encroachment will require modifying the existing

buffer according to RZC §21.64.030.B.6 (Buffer Reduction) and RZC §21.64.030.B.7 (Buffer Averaging. RZC §21.64.030.B.6 states:

6) Reduction in Buffer Widths. The Department may allow the standard wetland buffer width to be reduced in accordance the best available science on a case-by-case basis when it is determined that a smaller area is adequate to protect the wetland functions and values based on site-specific characteristics.

   a) Reduction in buffer width based on reducing the intensity of impacts from proposed land uses. The buffer widths recommended for land uses with high-intensity impacts to wetlands can be reduced to those widths recommended for moderate-intensity impacts under the following conditions:

      i) For wetlands that score moderate or high for habitat (20 points or more[4]), the width of the buffer around the wetland can be reduced if both of the following criteria are met:

         A. A relatively undisturbed vegetated corridor at least 100 feet wide is protected between the wetlands and any other priority habitats as defined by the Washington State Department of Fish and Wildlife. The corridor must be protected for the entire distance between the wetland and the priority habitat via some type of legal protection such as a conservation easement.

         B. Measures to minimize the impacts of different land uses on wetlands, such as those developed by the Department of Ecology under BAS, are applied.

            Wetland A scores as low functioning based on the current (2014) wetland rating system guidance from the Washington Department of Ecology. Therefore, §21.64.030.B.6.i does not apply.

      ii) For wetlands that score less than 20 points for habitat, the buffer width can be reduced to that required for moderate land use impacts if measures to minimize the impacts of different land uses on wetlands, such as those developed by the Department of Ecology under BAS, are applied.

         As stated above, Wetland A scores as low functioning based on the current (2014) wetland rating system guidance from the Washington Department Ecology. Therefore, the 'reduced standard buffer" for Wetland A is reduced from 50-ft to 40-ft.

Reducing the buffer for Wetland A from 50-ft to 40-ft will not provide sufficient area to construct the proposed access road in the Site's northwestern corner. Therefore, it will be necessary to "move" the eastern boundary of Wetland A westward through the

[4] The current Redmond Zoning Code requires the use of the 2014 Washington State Wetland Rating System for Western Washington, but still quotes habitat scores based on the 2004 wetland rating system. In this case, a score of 20 was considered to be the dividing score between low functioning buffers and moderately functioning buffers. Based on current DOE guidelines for habitat functions, a score of 5 or less is considered to be low functioning and a score of 6 to 8 is considered to be moderately functioning.

process of "wetland as buffer," or "paper fill"[5] and buffer averaging. No actual wetland will be physically lost due to fill. Rather, an area of wetland will be considered "filled" for regulatory purposes and will be mitigated as if it had been filled. There will actually be a net increase in the actual wetland area resulting from this process. Buffer reduction through buffer averaging must be based on the original 50-ft standard buffer, not the 40-ft reduced standard buffer. The averaged buffer width must not be less than 75 percent of the standard buffer width (37.5 feet). This maximum reduction is taken off of the reduced 40-foot standard buffer width for the purposes of calculating the required amount of mitigation. The steps for buffer averaging are provided under §21.64.030.B.7, which states:

7) Wetland Buffer Width Averaging. Wetland buffer widths may be modified by averaging buffer widths as set forth herein. The Department may allow modification of the standard wetland buffer width in accordance with the best available science on a case-by-case basis by averaging buffer widths. Averaging buffer widths may only be allowed where a qualified wetland professional demonstrates that:

   a) It will not reduce the functions or values;

      The buffer on the southern and western sides of Wetland A is heavily infested with Himalayan blackberry, which tends to reduce the ability of the buffer to provide higher-quality functions and values. The area of buffer reduction will be upslope of the existing and proposed Site development and will, therefore, not be directly affected by potential untreated stormwater discharges. Mitigation for the reduced buffer will include removal of non-native invasive species and replanting with a variety of native trees and shrubs. The mitigated buffer for Wetland A should provide substantially improved habitat functions compared with existing conditions.

   b) The wetland contains variations in sensitivity due to existing physical characteristics or the character of the buffer varies in slope, soils, or vegetation, and the wetland would benefit from a wider buffer in places and would not be adversely impacted by a narrower buffer in other places;

      *As stated in our response for "*Item a" *above, the existing buffer for Wetland A is infested with non-native blackberries and is upslope of the existing and proposed buffers. Reducing the buffer adjacent to the proposed development will not adversely impact the buffer's ability to protect against inputs of untreated stormwater or pollutants.*

   c) The total area contained in the buffer area after averaging is no less than that which would be contained within the standard buffer;

      The combination of converting wetland to buffer along with the allowed reduction of the standard buffer by 25 percent will result in a loss of approximately 1,261 sf

[5] Wetland as buffer is described in Chapter 6.6.3 of "Wetland Mitigation in Washington State – Part 1 (Washington State Department of Ecology, U.S. Army Corps of Engineers Seattle District, and the U.S. Environmental Protection Agency, Region 10 (2006).

of buffer. The proposed mitigation plan will replace this loss of buffer area by providing approximately 3,549 sf of new buffer at a ratio of approximately 2.8:1. and

d) The buffer width is not reduced more than 25 percent of the width or 50 feet, whichever is less, except for buffers between Category IV wetlands and low- or moderate-intensity land uses.

We have based our calculations on the area of buffer reduction based on the 50-ft standard buffer width. The code allows a 25 percent reduction of the standard buffer width, which will result in a reduced buffer width of no less than 37.5 feet.

Stream 1 under existing conditions has essentially no functioning buffer along its right bank due to existing Site development. Construction of the proposed access road will require that the stream, as it exists in the Site's northwestern corner, be moved (The City of Redmond does not allow placing streams into a pipe, with the exception of culverts under an existing or proposed road. A new stream channel will be constructed to the west of the existing channel. The new channel will be approximately 194 lf long and will terminate within the "wetland as buffer" area for Wetland A. The streamflow will be collected within the buffer area by a catch basin protected by a birdcage structure. An extension of an existing culvert under an access road located in the Site's northwestern corner (this road provides access to the property to the north of the Site) will collect water flowing into the catch basin and will discharge into the existing stream channel along the Site's northern boundary. The invert of the catch basin will be set at a level that will ensure that a minimum water depth is maintained during the rainy season, and to dissipate excess energy from the flowing water. This new extended culvert will be approximately 102 feet long. The total length of Stream 1 on the Site will be increased by 42 lf to 791 lf. See **Table 2** for a summary of impacts to Stream 1.

Table 2. Stream 1 Impacts and Mitigation (See also, Stream Summary Sheet, Appendix F)

Impact Type	Impact Length (linear feet)	Mitigation Type	Mitigation Length
Existing Open Channel*	195 lf	New Channel	194 lf**
Existing Culverts	90 lf	New Culvert Extension	102 lf

*Measured from the western property boundary to the upstream end of the existing culvert under the access road.

**The apparent loss of stream channel length is actually the result of measuring stream channel length from the western property boundary to the proposed catch basin. The proposed extended culvert is approximately 64 feet longer than the existing culvert to be replaced. The total length of Stream 1 after mitigation will be longer than its current length.

The existing stream channel is approximately 2 feet wide and flows through four culverts, one of which is under an existing access road to the property to the north. The remaining three culverts provide no function whatsoever. One of the unnecessary culverts cannot be removed. This culvert, which is east of the aforementioned access road, is currently entwined with the roots of a landmark big-leaf maple. The project arborist has determined that removing the culvert will likely damage the tree's roots and

jeopardize the survival of this tree. Therefore, the culvert will remain in place and will be coated on the inside with an epoxy coating to prevent the leaching of toxic metals into the stream. The unnecessary culvert located southwest of the access road will be removed as a result of grading for the new building emergency access road. The remaining unnecessary culvert will be removed, and the stream channel restored with suitable stream gravel material.

The new stream channel will be approximately 3 feet wide providing an increase of approximately 214 sf of channel (390 sf under existing Site conditions vs 604 sf of new channel per the proposed mitigation plan). Overall, there will be an increase in the total length of open channel of 64 lf resulting from the removal of unnecessary culverts and the proposed stream relocation.

Chapter 8. DETAILED MITIGATION PLAN

8.1 Proposed Mitigation Plan

Mitigation for the relocation of Stream 1 will be addressed through enhancement planting of the new buffer for Stream 1 and the restoration planting of the buffer for Wetland A (**Sheet W3.0, Appendix A**). Mitigation for the conversion, on paper only, of wetland to buffer is proposed. No actual fill of wetland will occur resulting from the conversion on paper of wetland into buffer.

Mitigation for the proposed impacts to Stream 1 will involve the restoration and enhancement of the remaining stream buffer on the subject property. In addition, a corrugated metal culvert, which currently serves no purpose, will be removed from the existing stream channel along the north property boundary. A second culvert in this same channel reach will be retained and treated with an epoxy coating in order that a landmark tree can be saved. The total length of culvert removal is 11 linear feet. In the northwest corner of the site, approximately 16,443 sf of combined stream and wetland buffer will be enhanced and approximately 490 sf of wetland will be created. The remaining on-site portion of stream buffer along the northern property boundary (7,643 sf) will be enhanced by removal of non-native, invasive species, including lawn, and replanting with a variety of native trees and shrubs. Most existing trees located in the remaining stream buffer area will be retained (see **Sheet W2.1, Appendix A** for existing and proposed profiles for Stream 1).

Areas disturbed during construction for the proposed access road and culvert will be recontoured to a maximum 3:1 slope and replanted with a variety of native trees and shrubs. Approximately 490 sf of new wetland will be created to partially offset the proposed wetland as buffer conversion (468 sf) in Wetland A. In the unlikely event further mitigation area is necessary to offset the conversion of wetland into buffer, purchase of mitigation credits at a wetland mitigation bank will be considered. Finally, approximately 10,576 sf of buffer temporarily disturbed by grading for the new stream channel will be restored and the remaining 15,629 sf of wetland and stream buffer will be enhanced by removal of non-native, invasive species such as Himalayan blackberry, and selectively planted with native conifer trees to improve species and structural diversity that is currently lacking. The total area of wetland creation, buffer restoration,

and buffer enhancement, both in and adjacent to critical areas, will be approximately 26,205 sf and will provide substantially better riparian habitat compared to existing conditions for areas of undisturbed and mitigated critical area types and their related buffers (see **Table 3**).

Table 3. Undisturbed, Mitigated, and Associated Buffer Areas (Sheet W1.3, Appendix A)

Wetland(s) and/or Stream(s)	Area (square feet) of undisturbed wetland/stream	Area (square feet) of mitigated wetland/stream	Area (sf) and width (feet) of buffers	Linear feet (lf) along the centerline of undisturbed streams	Linear feet (lf) along the centerline of relocated stream, if any
STREAM '1' (749 lf, partially culverted)	928 sf (453 lf open channel + 44 lf culverts)	388 sf (194 lf)	16,371* sf / buffer width varies: 2.5 ft – 25 ft	495 lf**	194 lf + 102 lf culvert***
Culverts in Stream 1 (90 lf)	20 lf one existing culvert to remain in place			70 lf to be removed	102 lf to be installed
WETLAND A	**1,469 sf**	**468 sf******	**16,443* sf / 37.5 ft**	**N/A**	**N/A**
Compensatory wetland 1:1		490 sf			
Created Wetland as buffer			1,098 sf		
Existing area: total combined buffers			**21,751 sf**		
Proposed area: total combined enhancement			**26,205 sf**		

* Buffer areas of wetlands and stream overlap (8,728 sf) and are included in each of these figures.

** Undisturbed stream length has an unmodified buffer width with existing non-conforming use.

*** Replacing 195 lf + 59 lf culvert. Overall, Stream 1 will increase in length by 64 lf.

**** Area converted to wetland as buffer.

The major benefit of the proposed mitigation plan is the creation of approximately 194 lf of new stream channel provided with a well-vegetated and functioning buffer, the removal of two unnecessary culverts, the creation of approximately 490 sf of new wetland, and the enhancement of the remaining stream and wetland buffer on the property (approximately 26,205 sf). The stream channel along the north property boundary is currently frequently mowed and has little to no vegetative cover except for some existing large trees. The proposed enhancement of the buffer will help keep the temperature of the stream low to benefit fish habitat in the lower parts of the basin and

provide organic input that will support a healthier aquatic macroinvertebrate community (which could also help support fish habitat elsewhere in the lower basin). As previously stated, the enhancement of the combined wetland and stream buffer in the Site's northwestern corner, and proposed stream channel and wetland construction will improve species and structural diversity. This will, in turn, substantially improve the value of this area as habitat for a variety of birds and terrestrial animals.

8.2 Mitigation Sequencing

8.2.1 Avoidance, Minimization, and Mitigation

RZC Title §21.64.010.H.I outlines the steps required to minimize, avoid, or mitigate impacts to critical areas. These are:

1) "All significant adverse impacts to critical areas functions and values shall be mitigated. Mitigation actions by the applicant or property owner shall occur in the following sequence:

   a) Avoiding the impact altogether by not taking a certain action or parts of actions;

      Due to the needs of the client, the building must provide a minimum square footage area. It will not be possible to orient the building differently to provide the minimum area while avoiding all impacts to critical areas or their associated buffers.

   b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation, by using appropriate technology, or by taking affirmative steps, such as project redesign, relocation, or timing, to avoid or reduce impacts;

      The current site development plan is the result of several design iterations and represents the minimum amount of impact to critical areas or their associated buffers. The proposed building footprint and driveway have been studied closely relative to the client's project program, zoning code requirements, existing trees and critical areas, and emergency vehicle access requirements. The proposed design takes into account all of these requirements and utilizes the existing paved driveway area to minimize impacts to critical areas as well as other existing landscape conditions in the northern and western portions of the Site.

   c) Rectifying the impact to the critical area by repairing, rehabilitating, or restoring the affected environment to the conditions existing at the time of the initiation of the project;

      The proposed mitigation plan will substantially improve the overall quality of Stream 1 on the Site by providing a well-vegetated buffer along the Site's northwestern corner, providing new wetland area to offsite the conversion of wetland to buffer, and enhancing the remaining critical areas buffers along the northern property line.

d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action;

The proposed mitigation will be monitored and maintained for five years per City of Redmond requirements and for a minimum of 10 years per Corps requirements.

e) Compensating for the impact by replacing or providing substitute resources or environments; and/or

Impacts to Stream 1 will be mitigated by the creation of a new stream channel onsite. This channel will be protected by a well-vegetated buffer (which is currently lacking). In addition, the conversion of wetland into buffer will be mitigated by creating new wetland onsite.

f) Monitoring the hazard or other required mitigation and taking remedial action when necessary."

As stated for Item d above, the mitigation areas will be monitored and maintained for five years per City of Redmond requirements and for 10 years per Corps requirements.

RZC Title §21.64.010.J further stipulates that "[w]here impacts cannot be avoided and the applicant has exhausted feasible design alternatives, the applicant or property owner shall seek to implement other appropriate mitigation actions in compliance with the intent, standards, and criteria of this chapter. In an individual case, these actions may include consideration of alternative site plans and layouts, reductions in the density or scope of the proposal, and/or implementation of the performance standards listed in subsequent sections of this chapter".

The proposed building needs to be of a minimum size (in terms of square footage) in order to meet the requirements of the Client. The size requirement is driven by the anticipated number of employees, the size requirements for laboratories, and desired employee amenities. The layout of the building is a factor of the necessary work environment needed to conduct the lab's business. These requirements set the minimum design standards that need to be met.

Another design criterion that drove site design was the need to preserve as many trees as possible. RZC Title §21.72.060 provides the guidelines and incentives for tree preservation and protection. A significant number of trees exist within a shallow ravine on the Site. It makes sense from an architectural and structural standpoint to design the building around this ravine, thus preserving a large number of potentially significant trees. The resultant building design, therefore, is the result of maximizing usable space in the smallest footprint possible while preserving as many trees as possible.

A substantial portion of space for any type of development is the need to provide parking for customers and employees. It is often easiest and least expensive to provide

an outside parking area. Outdoor parking would likely require more than six acres to accommodate the anticipated 794 cars. The Client will, instead, construct a multi-level partially below-grade parking facility that will not increase the overall footprint of the proposed building. The parking facility will accommodate 794 stalls. Access to the underground parking facility will be provided using some of the Site's existing road network. This will further reduce the need to remove trees for construction purposes.

The need to provide emergency vehicle access to the western side of the proposed building requires that a portion of the existing channel for Stream 1 be filled and the stream re-routed. This impact cannot be avoided based on building design requirements and Site constraints.

One concept that was initially considered in mitigating the impact to Stream 1 was to relocate the stream's channel approximately 25 feet to the west of the edge of the proposed access road. This would maintain an open channel and provide the required 25-foot buffer for a Class IV stream. This option was initially rejected since it would require considerable excavation into the hillside to create the new channel, and would not provide any guarantees that Stream 1 would not eventually erode its right bank and potentially overflow onto the access road. Rather, the stream was to be placed within a new pipe connecting to an existing culvert under an access road located in the Site's northwestern corner. After an initial review with the City of Redmond, the creation of a new stream channel was reinstated. Placing the stream in a new pipe is not allowed under City of Redmond zoning codes. The current stream channel creation includes several features to prevent the aforementioned erosion along the stream's right bank.

In addition to the proposed rerouting of Stream 1, the current site development plans will encroach to within approximately 10 feet of a wetland (Wetland A) that is located in the Site's northwestern corner. This is an unavoidable impact due to the design requirements of the proposed access road. This encroachment is greater than the allowed buffer reduction of a Category IV wetland.

The encroachment of the new access road into the buffer for Wetland A will be offset by the conversion of wetland into buffer. No greater than 468 sf of wetland will be converted into buffer in order to provide the required 50-foot standard (37.5-foot allowed) Category IV wetland buffer. No actual wetland fill will occur. Disturbed stream and wetland buffer will be restored and replanted onsite.

Mitigation for the conversion of wetland into buffer must follow the general guidelines provided under RZC §21.64.030.C.8, which states:

8) "Wetland Replacement Ratios
    a) Where wetland alterations and permitted by the City, the applicant shall restore or create areas of wetlands in order to compensate for wetland losses. Equivalent areas shall be determined according to the acreage, function, type, location, timing factors, and projected success of restoration or creation.

b) When creating or enhancing wetlands, the following acreage replacement ratios shall be used:

Table 21.64.030B
Acreage Replacement Ratios

Category and Type of Wetland	Creation or Reestablishment	Rehabilitation (Restoration)	Reestablishment or Creation (R/C) and Enhancement (E)	Reestablishment or Recreation (R/C) and Rehabilitation (RH)	Enhancement Only
Category I Forested	6:1	12:1	1:1 R/C and 10:1 E	1:1 R/C and 10:1 RH	24:1
Category I based on score	4:1	8:1	1:1R/C and 6:1 E	1:1 R/C and 6:1 RH	16:1
Category II	3:1	8:1	1:1 R/C and 4:1 E	1:1 R/C and 4:1 RH	12:1
Category III	2:1	4:1	1:1 R/C and 2:1 E	1:1 R/C and 2:1 RH	8:1
Category IV	1.5:1	3:1	1:1 R/C and 2:1 E	1:1 R/C and 1:1 RH	6:1

c) Increased Replacement Ratio. The Department may increase the ratios under the following circumstances:

i) Uncertainty exists as to the probability success of the proposed restoration or creation; or

ii) A significant period of time will elapse between impact and establishment of wetland functions; or

iii) Proposed mitigation will result in a lower category wetland or reduced functions relative to the wetland being impacted; or

iv) The impact was unauthorized.

d) Decreased Replacement Ratio. The Department may decrease these ratios under the following circumstances:

i) Documentation by a qualified wetland specialist demonstrates that the proposed mitigation actions have a very high likelihood of success;

ii) Documentation by a qualified wetland specialist demonstrates that the proposed mitigation actions will provide functions and values that are significantly greater than the wetland being impacted; of

iii) The proposed mitigation actions are conducted in advance of the impact and have been shown to be successful.

e) Enhanced and created wetlands shall be appropriately classified and buffered.

At the discretion of the City of Redmond Planning Department, impacts to the Category IV wetlands will be offset through the creation of new wetland at a ratio of 1:1 (creation to impact). The proposed mitigation plan will provide approximately 490 sf of wetland creation, resulting in a total wetland area slightly greater than the 468 sf of impacted wetland. In addition, approximately 1,469 sf of existing wetland will be enhanced for an enhancement ratio of approximately 3:1.

8.2.2 Mitigation Standards, Criteria, and Plan Requirements

RZC Title §21.64.010.L describes mitigation standards, criteria, and plan requirements. These are:

1) "Mitigation Performance Standards. Significant adverse impacts to critical area functions and values shall be mitigated. Mitigation actions shall be implemented in the preferred sequence identified in RZC Title §21.64.010.I *General Mitigation Standard*, which include less preferred and/or compensatory mitigation shall demonstrate that:

   a) All feasible and reasonable measures will be taken to reduce impacts and losses to the critical area or to avoid impacts where avoidance is required by these regulations;"

      As stated in this Section, the current site design represents a substantial effort by the Client to minimize the footprint of the proposed building in order to preserve as many existing trees on the property as possible. Efforts to minimize the building footprint include a multi-level underground parking facility for employees and visitors. The current design will unavoidably impact approximately 195 lf of open channel and 59 lf of existing culverts of a Class IV stream. The remaining approximately 465 lf of Class IV stream channel along the north property boundary will not be impacted beyond the removal of an existing unnecessary CMP culvert.

      and

   b) The restored, created, or enhanced critical area or buffer will be as viable and persistent as the critical area or buffer area it replaces;"

      As stated in this section, an initial concept for mitigating the unavoidable impact to Stream 1 resulting from the proposed access road was to create a new channel approximately 25 feet west of the new road's edge. It was reasoned at the time that the long-term stability of this solution could not be guaranteed and that there was a significant likelihood that Stream 1 might erode its right bank and flood the access road. However, the City of Redmond Zoning Code does not allow for streams to be placed in pipes, with the exception of culverts under roadways. Therefore, the new stream channel concept was revived and revised.

      The current mitigation plan will create approximately 194 lf of new stream channel that will provide a fully vegetated buffer adjacent to development. The proposed new stream channel will utilize technologies that will prevent the possibility of erosion of stream banks and downcutting of the stream channel.

      and

   c) In the case of wetlands and riparian stream corridors, no overall net loss will occur in wetland or riparian stream corridor functions and values".

Stream 1 is identified as a City of Redmond Class IV stream, meaning that it is intermittent and provides no fish habitat. From our observations, it appears that Stream 1 does not flow all the way to Willows Road NE during most parts of the year (it infiltrates approximately 400 ft from Willows Road NE). Based on available GIS data, it appears that much of the flow in Stream 1 results from stormwater discharge from NE 103rd Street to the west. The reach of Stream 1 that will be impacted consists of a gravel-lined constructed channel with essentially no vegetative cover and no woody debris, thus providing no habitat value. The proposed new stream channel will be protected by a fully vegetated buffer and will contain many habitat features. It is anticipated that the new stream channel will provide substantially better functions and values compared to existing conditions.

The proposed enhancement of the remaining stream buffer along the northern property line will significantly improve the habitat value of the stream by helping to keep the temperature of the streamflow low and providing valuable habitat for aquatic macroinvertebrates. Both are essential to the health of fish habitat elsewhere in the basin downstream of the Site.

2) Location and Timing of Mitigation

a) "Mitigation shall be provided on-site unless on-site mitigation is not scientifically feasible due to physical features of the property. The burden of proof shall be on the applicant to demonstrate that mitigation cannot be provided on-site".

Proposed mitigation for the impacts to Stream 1 includes enhancement of the existing stream buffer. Approximately 7,643 sf of the existing stream and 8,728 sf of temporarily disturbed stream and wetland buffer will be enhanced. Areas disturbed by the creation of the new wetland areas and new stream channel will be restored and replanted with a variety of native trees and shrubs. A total of approximately 26,205 sf of buffer area will be restored.

Mitigation for the conversion of approximately 468 sf of Category IV wetland into buffer will be fully mitigated through the creation of approximately 490 sf of new wetland.

b) When mitigation cannot be provided on-site, mitigation shall be provided in the immediate vicinity of the permitted activity on property owned or controlled by the applicant, such as an easement, provided such mitigation is beneficial to the critical area and associated resources.

Mitigation for stream relocation and buffer impacts will occur onsite.

c) In-kind mitigation shall be provided except when the applicant demonstrates and the Department concurs that greater functional and habitat value can be achieved through out-of-kind mitigation.

Mitigation for buffer impacts shall be in-kind. The type of mitigation for the conversion of wetland into buffer will be through the creation of new wetland and the enhancement of the existing wetland (per RZC Table 21.64.030B).

d) Only when it is determined by the Department that subsections L.2.a, and L.2.b of this section are inappropriate and impractical, shall off-site out-of-kind mitigation be considered.

Buffer impacts shall be mitigated onsite. Mitigation for the conversion of wetland into buffer will be fully covered through the creation of new wetland onsite.

e) When wetland or riparian stream corridor mitigation is permitted by these regulations on-site or off-site, the mitigation project shall occur near an adequate water supply (river, stream, groundwater, stormwater facility outfall) with a hydrologic connection to the critical area to ensure successful development or restoration.

There will be no alterations to the supply of water to Stream 1 resulting from the proposed development. However, it may be necessary to provide irrigation to the enhancement plantings until such materials are well established and able to survive on their own.

There will be no loss of actual wetland area resulting from the proposed conversion of wetland to buffer. Mitigation for this conversion will be provided, in part, through the creation of new wetland area. Hydrology for the new wetland area will be provided by the existing flow from Stream 1 through its new channel. In addition, hydrology to Wetland A will be maintained and supplemented by flow from Stream 1. Since Wetland A is a slope wetland, the increase of hydrology provided by diverting Stream 1 into it will not negatively impact the wetland as a whole.

f) Any agreed upon mitigation proposal shall be completed concurrently with project construction, unless a phased schedule that assures completion prior to occupancy has been approved by the Department.

All onsite mitigation work will occur concurrently with the proposed project construction.

g) Wetland acreage replacement ratios shall be as specified in RZC Title §21.64.030.C.7.b, *Wetland Replacement Ratios*.

The mitigation for the conversion of 468 sf of wetland into buffer will occur at a 1:1 ratio per City of Redmond Zoning Code. No less than 468 sf of wetland must be created to offset the impact of converting 468 sf of Category IV wetland into buffer. The project will create approximately 490 sf of new wetland for a net increase of approximately 22 sf of wetland.

h) Restored or created riparian stream corridors, where permitted by these regulations, shall be an equivalent or higher riparian stream corridor value or function than the altered riparian stream corridor.

The current riparian stream corridor consists of lawn and some large trees, with a portion of the stream's right bank having no vegetated buffer. Much of the existing stream buffer area is regularly mowed and therefore provides no riparian cover for the stream. The proposed relocation of the stream will provide a fully vegetated stream buffer west of the project site. The enhancement of the remaining stream buffer will substantially improve the habitat value of the existing riparian stream corridor compared to existing conditions.

i) All off-site mitigation shall be provided within the Redmond city limits."

No off-site mitigation is being requested.

8.3 Stream Buffer Restoration/Enhancement

Approximately 16,371 sf of stream buffer areas will be restored and enhanced to provide protective functions to Stream 1. The buffer areas are depicted on **Sheet W1.3, Appendix A**. The stream buffer has limited functions and values and consists mainly of either mowed lawn or blackberry with some large trees on the north property line. Buffer restoration/enhancement measures will include:

1) clearing and grubbing all exotic and invasive weedy species in the buffers,
2) debris removal,
3) minor grading to install the piped segment of the stream and culvert removal;
4) placement of topsoil,
5) placement of down logs per WDFW requirements,
6) providing 3-inches of bark mulch in all cleared, grubbed, and graded buffer areas, and
7) planting a variety of native deciduous and evergreen tree, shrub, and groundcover species.

Newly planted vegetation in non-graded portions of the enhanced buffer areas will be integrated with the existing trees that will be retained. Native plantings will create more diverse plant communities and provide enhanced wildlife forage and cover habitats and

water quality protection to the riparian corridor. The placement of down logs will further increase the natural biological support, overall habitat, and specific habitat functions.

8.4 Mitigation Design Elements

8.4.1 Plant Community Plan

A preliminary Plant Schedule with the proposed plant species including size and spacing is provided on **Sheet W3.0, Appendix A**. Plant species were chosen for a variety of qualities, including adaptation to specific water regimes, value to wildlife, value as a physical or visual barrier, patterns of growth (structural diversity), and aesthetic values. Native tree, shrub, and herbaceous species were chosen to increase both the structural and species diversity of the mitigation areas, thereby increasing the value of the area to wildlife for food and cover. Plant materials will consist of a combination of cuttings, ball and burlapped, bare-root specimens, and container plants.

8.4.2 Large Woody Material

Large woody material will be placed within the mitigation site as outlined in the mitigation plan sheets (**W2.0, Appendix A**). Details on large wood material stability have been evaluated by GeoEngineers and the results are provided as (**Appendix D**).

8.4.3 Temporary Irrigation System

An above-ground temporary irrigation system capable of full head to head coverage of all planted areas will be provided for the mitigation areas. The temporary irrigation system shall either utilize controller and point of connection (POC) from the site irrigation system or shall include a separate POC and controller with a backflow prevention device per water jurisdiction inspection and approval. The system shall be zoned to provide optimal pressure and uniformity of coverage, as well as separation for areas of full sun or shade and slopes in excess of 5% grade.

The system shall be operational by June 15 (or at the time of planting) and winterized by October 15. Irrigation shall be provided for the first 2 years of the monitoring period. The irrigation system shall be programmed to provide 1/2" of water per week (one cycle with two start times per week or every three days). A chart describing the location of all installed or open zones and corresponding controller numbers shall be placed inside the controller and given to the owner’s representative. Prior to the release of the bond at the end of the City-required five-year monitoring period, all components of the above-ground temporary irrigation system shall be removed from all of the mitigation areas.

8.5 Mitigation Goals, Objectives, and Performance Standards

The primary goal of the proposed mitigation plan is to substantially enhance the remaining portion of the on-site stream buffer to improve overall riparian corridor habitat functioning and to mitigate for conversion of wetland into buffer. To accomplish these goals, the proposed project will:

- Enhance and restore 7,643 sf of Stream 1 buffer along the northern property boundary and approximately 16,425 sf of combined Wetland A and Stream 1 buffer located in the northwest property corner for a total of approximately 24,086 sf of buffer enhancement,

- Create approximately 490 sf of new wetland associated with Stream 1; and
- Enhance and restore approximately 13,423 sf of temporarily impacted wetland and stream buffer.
- Enhance approximately 4,461 sf of existing natural landscape to mitigate the reduced existing wetland buffer.
- Create no less than 490 sf of new wetland to mitigate for the conversion of 468 sf of wetland into buffer.

Mitigation actions will be evaluated through the following objectives and performance standards. See **Section 10.3** for a full description of the monitoring methods that will be used to evaluate the approved performance standards. Mitigation monitoring will be performed by a qualified biologist.

Objective A – Create structural and plant species diversity in the enhanced and restored stream and wetland buffers.

Performance Standard A1*: At least 10 species of desirable native plants will be present in the mitigation areas during the monitoring period. Percent survival of planted woody species must be at least 100% at the end of Year 1 (per contactor warranty), and at least 80% for each subsequent year of the monitoring period.*

Performance Standard A2: *Total percent aerial woody plant coverage must be at least 35% by Year 4 and 50% by Year 5. Woody coverage may be comprised of both planted and recolonized native species; however, to maintain species diversity, at no time shall a recolonized species (i.e., red alder) comprise more than 35% of the total woody coverage. There must be at least three native species providing at least 20% each, or four native species providing at least 15% each, or five native species providing at least 10% of the total aerial woody plant coverage.*

Objective B: Create habitat structure and plant species diversity in the created wetland, and wetland enhancement areas.

Performance Standard B1: *At least 2 species of desirable native plants will be present in the created wetland during each year of the monitoring period.*

Performance Standard B2: *Percent survival of all planted woody species must be at least 100% at the end of Year 1 (per contractor warranty), and at least 80% for each subsequent year of the monitoring period.*

Performance Standard B3: *Created Emergent Wetland: Coverage of herbaceous vegetation shall be at least 30% by the end of Year 1, 50% by the end of Year 2, and 65% by the end of Year 5, excluding those areas of the site that may have sparse herbaceous vegetation due to dense shade from woody species coverage.*

Objective C: Create approximately 490 sf of new wetland.

Performance Standard C1*: At the end of the five-year monitoring period, there should be approximately 490 sf of newly created wetland area (no less than 468 sf to offset the impacted area at a 1:1 ratio).*

Performance Standard C2*: At least 5 species of tree, 10 species of shrubs, and six species of emergent vegetation shall be present in the wetland and wetland buffer mitigation area during the monitoring period. Percent survival of planted woody species must be at least 100% at the end of Year 1 (per contactor warranty), and at least 80% for each subsequent year of the monitoring period.*

Performance Standard C3*: Total percent aerial woody plant coverage must be at least 35% by Year 4 and 50% by Year 5. Woody coverage may be comprised of both planted and recolonized native species; however, to maintain species diversity, at no time shall a recolonized species (i.e., red alder) comprise more than 35% of the total woody coverage. There must be at least three native species providing at least 20% each, or four native species providing at least 15% each, or five native species providing at least 10% of the total aerial woody plant coverage.*

Objective D: Created wetland must exhibit wetland hydrology.

Performance Standard D1: *Wetland Hydrology: After construction, the created wetland areas shall exhibit 14 or more consecutive days of hydrology during the growing season in each year of normal rainfall (based on a normal precipitation analysis). Evidence of wetland hydrology may include evidence of saturated soil conditions (i.e., signs of ponding, a water table near the surface, watermarks, water-stained leaves, or oxidized rhizospheres). In addition, a combination of native or naturalized woody and herbaceous vegetation that is predominantly FAC or wetter will cover the wetland areas. Hydrology shall be monitored annually concurrent with either spring or fall monitoring events.*

Objective E: Limit the amount of invasive and exotic species within the mitigation area.

Performance Standard E1*: After construction and following every monitoring event for a period of five years, exotic and invasive plant species will be maintained at levels below 20% total cover throughout the mitigation areas. These species include Scot's broom, Himalayan and evergreen blackberries, reed canarygrass, purple loosestrife, hedge bindweed, and creeping nightshade.*

Performance Standard E2: *After construction and following every monitoring event for a period of five years, Japanese knotweed will be completely removed from the mitigation area, if found. There will be 0% total cover of this species.*

Chapter 9. CONSTRUCTION SEQUENCING

9.1 Mitigation Construction Sequencing

The following provides the general sequence of activities anticipated to be necessary to complete this mitigation project. Some of these activities may be conducted concurrently as the project progresses.

1) Conduct a site meeting between the Contractor, Talasaea Consultants, and the Owner's Representative to review the project plans, staging and stockpile areas, and material disposal areas.
2) Survey clearing limits and install silt fencing and any other erosion and sedimentation control BMPs per the civil plans.
3) Complete the stream piping and culvert removal.
4) Place down logs in stream channel per WDFW.
5) Place topsoil.
6) Mulch all disturbed buffer areas.
7) Complete site cleanup and install plant material as indicated on the Mitigation Planting Plan.
8) Install critical area signs and fencing.

A wetland ecologist or landscape architect will regularly supervise the planting plan implementation to ensure that the objectives and specifications of the plan are met. Any significant modifications to the design that may occur as a result of unforeseen circumstances will be approved by the Owner, the City, and Talasaea Consultants prior to their implementation.

9.2 Post-Construction Approval

Talasaea Consultants shall notify the City of Redmond in writing when the mitigation planting is completed for a final site inspection and subsequent final approval. Once final approval is obtained in writing from the City, the monitoring period will begin.

9.3 Post-Construction Baseline Assessment

Once construction is approved, a qualified ecologist from Talasaea Consultants shall conduct a post-construction assessment of the mitigation site. The purpose of this assessment will be to establish baseline conditions at Year 0 of the required monitoring period. A Baseline Assessment report including "as-built" drawings will be submitted to the City of Redmond. The as-built plan set will identify and describe any changes in planting or other constructed features in relation to the original approved plan.

Chapter 10. MONITORING PLAN

10.1 Monitoring Schedule

Performance monitoring of the mitigation area will be conducted for a period of five years pursuant to RZC Title §21.64 Appendix 1(G)(9). Monitoring will be conducted according to the schedule presented in **Table 4** below. All monitoring will be conducted by a qualified biologist or ecologist.

Table 4. Projected Schedule for Performance Monitoring and Maintenance Events

Year	Date	Maintenance Review	Performance Monitoring	Report Due to Agencies
1	Spring	X	BA[1]	X
	Fall	X	X	X
2	Spring	X	X	
	Fall	X	X	X
3	Spring	X		
	Fall	X	X	X
4	Spring	X		
	Fall	X	X	X
5	Spring	X		
	Fall	X	X	X[2]

[1] BA = Baseline Assessment following construction completion.

[2] Obtain final approval from the City of Redmond (presumes performance criteria are met).

10.2 Monitoring Reports

Each monitoring report will adhere to the requirements of RZC Title §21.64.010(P) and will also utilize the Corps document titled "Annual Monitoring Report Format Requirements", (USACE Regulatory Guidance Letter No. 08-03, OCT 2008). The reports will include: 1) Project Overview, 2) Requirements, 3) Summary Data, 4) Maps and Plans, and 5) Conclusions.

10.3 Monitoring Methods

Vegetation monitoring shall be conducted according to RZC Title §21.64 Appendix 1(G)(9)(a)(i) and will include counts, photopoints, random sampling, sampling plots, quadrats, or transects; stem density; visual inspection; and/or other methods deemed appropriate by the City of Redmond. Vegetation monitoring components shall include general appearance, health, mortality, colonization rates, percent cover, percent survival, volunteer plant species, and invasive weed cover.

Permanent vegetation sampling plots, quadrats, and/or transects will be established at selected locations to adequately sample and represent all of the plant communities within the mitigation project areas. The number, exact size, and location of transects, sampling plots, and quadrats will be determined at the time of the baseline assessment.

Percent areal cover of woody vegetation (forested and/or scrub-shrub plant communities) will be evaluated using point-intercept sampling methodology. Using this methodology, a tape will be extended between two permanent markers at each end of an established transect. Trees and shrubs intercepted by the tape will be identified, and the intercept distance recorded. Percent cover by species will then be calculated by adding the intercept distances and expressing them as a total proportion of the tape length.

The established vegetation sampling locations will be monitored and compared to the baseline data during each performance monitoring event to aid in determining the success of plant establishment. Percent survival of shrubs and trees will be evaluated in a 10-foot-wide strip along each established transect. The species and location of all

shrubs and trees within this area will be recorded at the time of the baseline assessment and will be evaluated during each monitoring event to determine percent survival.

10.4 Photo Documentation

Photographs will be taken throughout the monitoring period. These photographs will document general appearance and relative changes within the plant community. A review of the photos over time will provide a semi-quantitative representation of the success of the planting plan. Vegetation sampling transect/plot/quadrat and photo-point locations will be shown on a map and submitted with the baseline assessment report and yearly performance monitoring reports.

10.5 Wildlife

Birds, mammals, reptiles, amphibians, and invertebrates observed in the wetland and buffer areas (either by direct or indirect means) will be identified and recorded during scheduled monitoring events and at any other time that observations are made. Direct observations include actual sightings, while indirect observations include tracks, scat, nests, song, or other indicative signs. The kinds and locations of the habitat with the greatest use by each species will be noted, as will any breeding or nesting activities.

10.6 Water Quality and Site Stability

Water quality will be assessed qualitatively; unless it is evident there is a serious problem. In such an event, water quality samples will be taken and analyzed in a laboratory for suspected parameters. Qualitative assessments of water quality include:

- oil sheen or other surface films,
- abnormal color or odor of water,
- stressed or dead vegetation or aquatic fauna,
- turbidity, and
- absence of aquatic fauna.

Observations will be made on the stability of slopes in the mitigation areas. Any erosion or slumping of the slopes will be recorded and corrective measures will be taken.

Chapter 11. MAINTENANCE AND CONTINGENCY

Regular maintenance reviews will be performed according to the schedule presented in Error! Reference source not found.**5** to address any conditions that could jeopardize the s uccess of the mitigation project. Following maintenance reviews by the biologist or ecologist, required maintenance on the site will be implemented within ten (10) business days of submission of a maintenance memo to the maintenance contractor and permittee.

Established performance standards for the project will be compared to the yearly monitoring results to judge the success of the mitigation. If during the course of the monitoring period there appears to be a significant problem with achieving the performance standards, the permittee shall work with the City of Redmond to develop a

Contingency Plan in order to get the project back into compliance with the performance standards. Contingency plans can include, but are not limited to, the following actions: additional plant installation, erosion control, modifications to hydrology, and plant substitutions of type, size, quantity, and/or location. If required, a Contingency Plan shall be submitted to the City of Redmond by December 31st of any year when deficiencies are discovered.

The following list includes examples of maintenance (M) and contingency I actions that may be implemented during the course of the monitoring period. This list is not intended to be exhaustive, and other actions may be implemented as deemed necessary.

- During year one, replace all dead woody plant material (M).
- Water all plantings at a rate of 1" of water every week between June 15 – October 15 during the first two years after installation, and for the first two years after any replacement plantings (C & M).
- Replace dead plants with the same species or a substitute species that meet the goals and objectives of the mitigation plan, subject to Talasaea and City approval I.
- Re-plant area after the reason for failure has been identified (e.g., moisture regime, poor plant stock, disease, shade/sun conditions, wildlife damage, etc.) I.
- Remove/control weedy or exotic invasive plants (e.g., Scot's broom, reed canarygrass, Himalayan blackberry, purple loosestrife, Japanese knotweed, etc.) by manual or chemical means approved by permitting agencies. The use of herbicides or pesticides within the mitigation area would only be implemented if other measures failed or were considered unlikely to be successful and would require prior agency approval. All non-native vegetation must be removed and disposed of off-site. (C & M).
- Weed all trees and shrubs to the drip line and provide 3-inch deep mulch rings 24 inches in diameter for shrubs and 36 inches in diameter for trees (M).
- Remove trash and other debris from the mitigation areas twice a year (M).
- Selectively prune woody plants at the direction of Talasaea Consultants to meet the mitigation plan's goal and objectives (e.g., thinning and removal of dead or diseased portions of trees/shrubs) (M).
- Repair damages to all affected properties and structures caused by erosion, settling, or other geomorphological processes.

Chapter 12. FINANCIAL ASSURANCES

Pursuant to RZC Title §21.76.090.B, a performance security device shall be secured by the Applicant to ensure that all mitigation work is completed according to the approved plans. The amount of the performance security will be 150 percent of the cost of the mitigation project for the length of the monitoring period. Reference **Appendix F** for the bond quantity worksheet.

Chapter 13. SUMMARY

The Building X Project is the redevelopment of an existing parcel. The parcel is currently developed with a commercial office building and associated infrastructure. A fringe of native mixed coniferous-deciduous forest exists along the western boundary of the parcel. A boundary line adjustment (BLA) has been applied to the parcel's southern boundary line creating a larger parcel. The parcel after the BLA will be approximately 8.9 acres versus the original parcel size of 7.07 acres.

One intermittent Class IV stream (Stream 1) and one Category IV wetland (Wetland A) were identified on the property. Stream 1 has a 25-foot standard buffer. Wetland A has a 50-foot standard buffer reduced to 37.5 feet through buffer averaging. The available buffer for Stream 1 along the Site's northern boundary is currently poorly vegetated and frequently mowed with a portion having no vegetated buffer along the stream's right bank. Current nonconforming uses within that buffer may be maintained, repaired, or expanded as long as the activities do not extend any closer to the riparian habitat (i.e., expansion must be away from the stream).

One habitat unit, Urban and Mixed Environments, was identified on the Site. Habitat within the Site does not support species of local importance, State-, or Federally-listed species.

The Client proposes to redevelop the Site with a new building that will accommodate office space, laboratories, and employee amenities. Parking for an estimated 1,045 cars will be provided by an underground multi-level partially below-grade parking garage under the proposed building and an additional eight aboveground stalls adjacent to the proposed building.

The design of the proposed building reflects the need to protect as many significant trees on the property as is possible. The proposed building will require a redesigned access road to its western side for emergency vehicles, such as fire engines. To accommodate the turning radius required by the emergency vehicles, the access road will need to fill a portion of the Class IV stream near the property's northwest corner and encroach to within 10 feet of Wetland A. In order to provide the minimum 37.5-foot buffer for Wetland A, approximately 468 sf of the wetland will be converted into buffer using the Washington Department of Ecology's "wetland as buffer" concept. There will be no actual fill or physical loss of wetland area resulting from the proposed conversion.

Approximately 195 lf of open stream channel and 59 lf of existing culverts will be impacted. The stream will be placed in a new channel (approximately 194 lf long) that will discharge into the newly-created buffer for Wetland A. Eleven (11) feet of unnecessary culverts will be removed and an existing 40-foot culvert will be extended to 102 feet to connect the new Stream 1 channel within the buffer for Wetland A to the existing channel along the Site's northern property boundary. Stream 1 will increase in length by approximately 64 lf. No other critical areas will be impacted as a result of the construction of this proposed building.

Mitigation for the proposed stream channel impact will be provided through the creation of a new channel. Two existing unnecessary and potentially undersized culverts will be removed from the channel along the northern property boundary. Non-native, invasive species will be removed, and the remaining stream buffer will be enhanced by planting a variety of native trees and shrubs. Areas disturbed during construction of the access road and pipe will be restored to provide a slope of no greater than 3:1 and will be planted with a variety of native trees and shrubs. Finally, the remaining area from the property's northwest corner to the proposed pipe and access road will be enhanced through the removal of non-native invasive species and selectively planted with conifers to improve species and structural habitat. The total area of stream buffer enhancement is approximately 16,371 sf. In addition, 7,715 sf of buffer impacted during construction will be restored. The total area of enhancement and restoration is approximately 26,205 sf. The mitigated area will provide substantially better habitat and protections to Stream 1 compared to existing conditions.

Mitigation for the conversion, on paper, of 468 sf of wetland into buffer will require the creation of no less than 468 sf of new wetland onsite. The conversion of 468 sf of wetland into buffer will be fully offset by the creation of 490 sf of new wetland and enhancement of approximately 1,469 sf of existing wetland (greater than 3:1 ratio).

Chapter 14. REFERENCES

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Figures

Figure 1: Vicinity Map & Driving Directions
Figure 2: Parcel Map
Figure 3: National Wetlands Inventory Map
Figure 4: NRCS Soils Map
Figure 5: City of Redmond GIS Database

SE 1/4 SEC. 34, TWP. 26N, RGE. 5E, W.M.

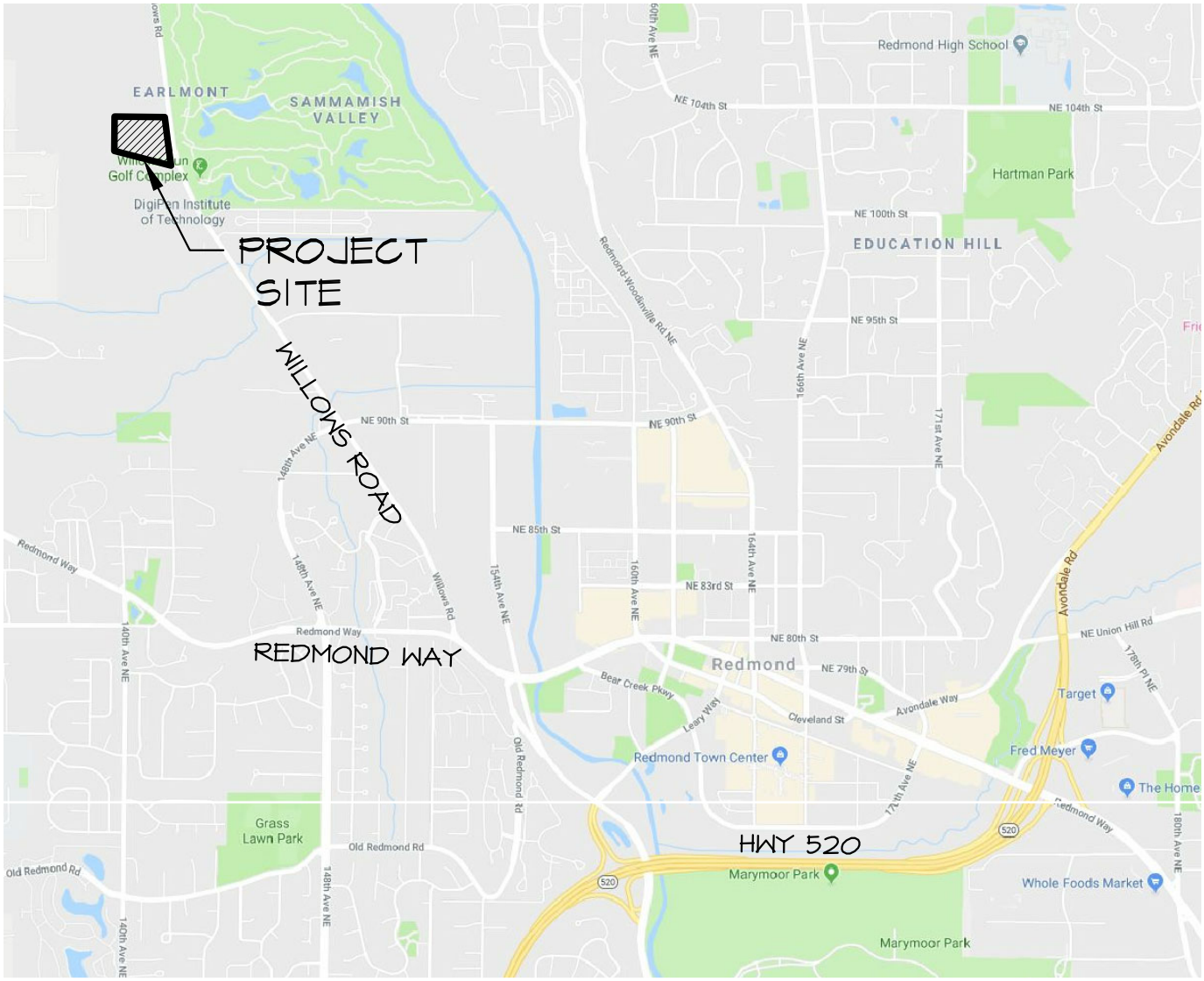

IMAGE SOURCE: GOOGLE MAPS, WWW.MAPS.GOOGLE.COM (ACCESSED 7 AUGUST 2018)

DRIVING DIRECTIONS:

FROM REDMOND CITY HALL -

1. HEAD WEST ON 85TH STREET TOWARDS THE SAMMAMISH RIVER TRAIL. CONTINUE FOR 0.2 MILES.
2. TURN RIGHT ONTO 154TH AVE NE. CONTINUE FOR 0.2 MILES.
3. TURN LEFT ONTO NE 90TH STREET. CONTINUE FOR 0.4 MILES.
4. TURN RIGHT ONTO WILLOWS ROAD. CONTINUE FOR 0.8 MILES.
5. DESTINATION WILL BE ON THE LEFT:

   10301 WILLOWS ROAD
   REDMOND, WA 98052.

NORTH

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Resource & Environmental Planning
15020 Bear Creek Road Northeast
Woodinville, Washington 98077
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FIGURE #1

VICINITY MAP & DRIVING DIRECTIONS
PHASE I - BUILDING X PROJECT
REDMOND, WASHINGTON

DESIGN	DRAWN	PROJECT
KM	KM	1732
SCALE		
NTS		
DATE		
10-10-2019		
REVISED		

1

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SE 1/4 SEC. 34, TWP. 26N, RGE. 5E, W.M.

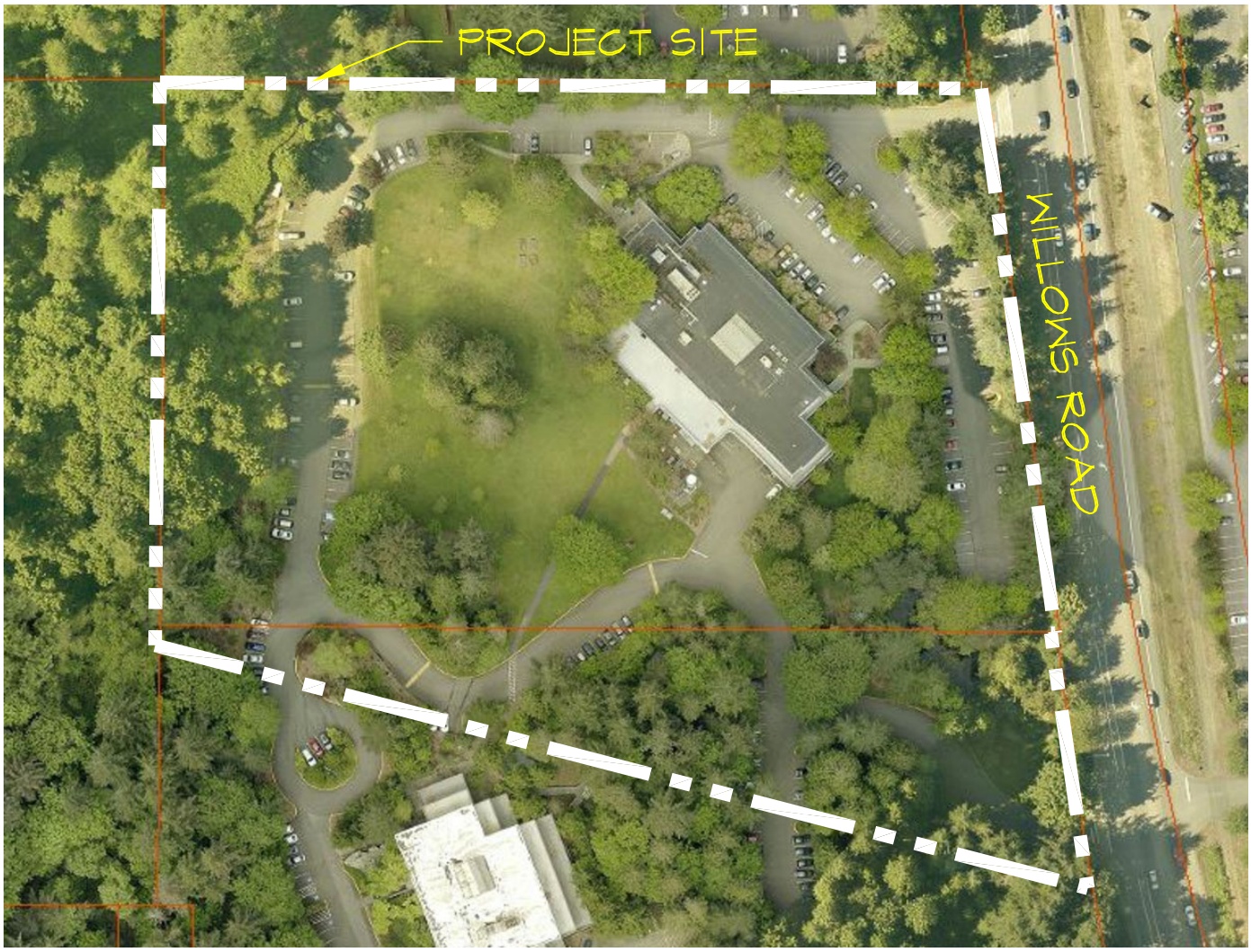

IMAGE SOURCE: KING COUNTY IMAP; HTTP://WWW.KINGCOUNTY.GOV/IMAP/VIEWER.HTM?MAPSET=KCPROPERTY (ACCESSED 13 JUNE 2018)

KEY	PARCEL	ACERAGE
SITE	3426059037	8.9 AC

NORTH

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FIGURE #2

PARCEL MAP
PHASE I - BUILDING X PROJECT
REDMOND, WASHINGTON

DESIGN	DRAWN	PROJECT
KM	KM	1732
SCALE		
NTS		
DATE		2
10-10-2019		
REVISED		

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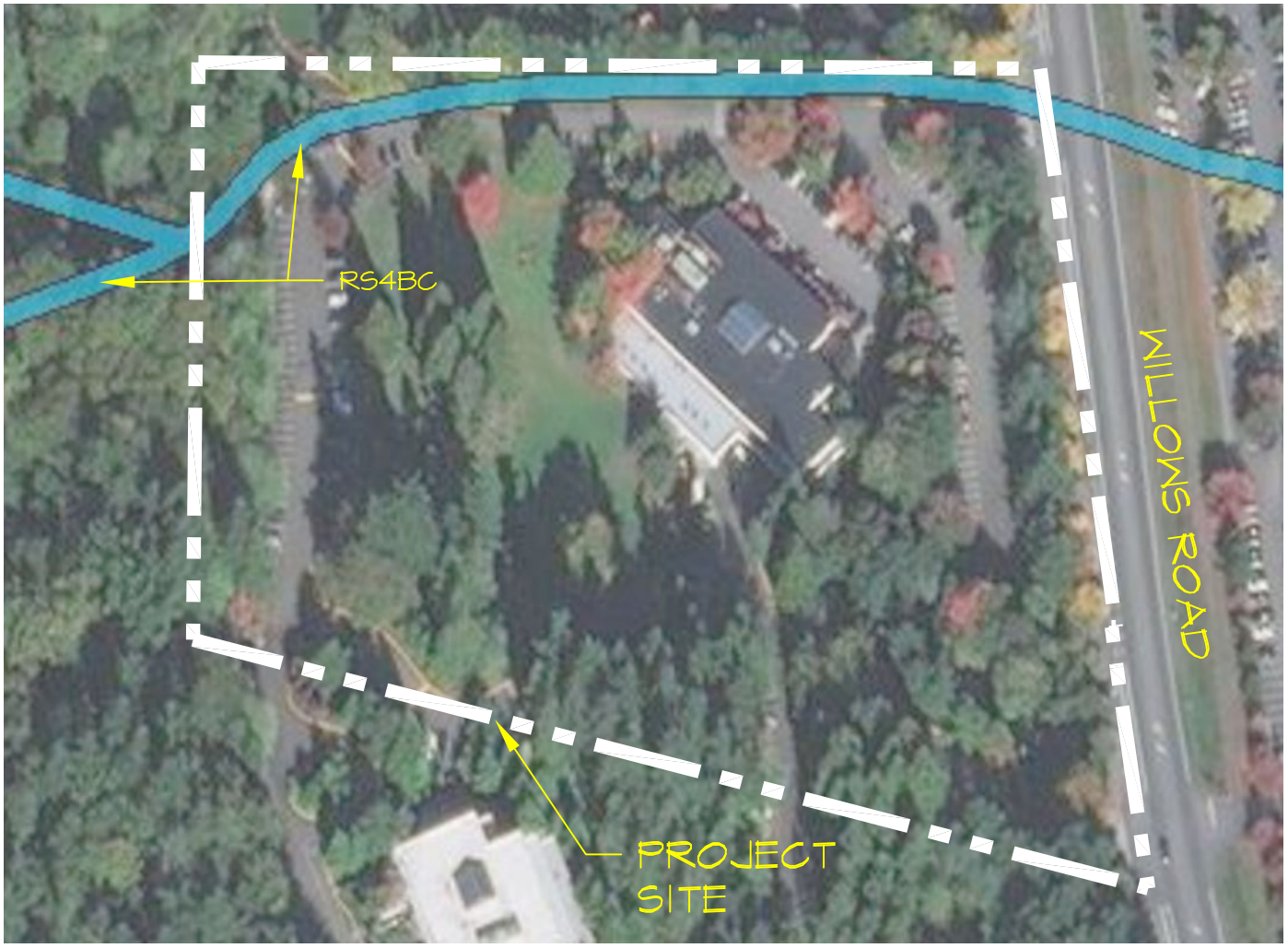
SE 1/4 SEC. 34, TWP. 26N, RGE. 5E, W.M.



LEGEND

TYPE	DESCRIPTION
RS4BC	RIVERINE, INTERMITTENT STREAMBED, SEASONALLY FLOODED.

SOURCE: U.S. FISH AND WILDLIFE SERVICE, (JAN 2018). NATIONAL WETLANDS INVENTORY WEBSITE, U.S. DEPARTMENT OF THE INTERIOR, FISH AND WILDLIFE SERVICE, WASHINGTON D.C. http://www.fws.gov/wetlands/data/wetland-codes.html (ACCESSED 12 JUNE 2018).

NORTH

N.T.S.

TALASAEA CONSULTANTS, INC.
Resource & Environmental Planning
15020 Bear Creek Road Northeast
Woodinville, Washington 98077
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FIGURE #3

NATIONAL WETLANDS INVENTORY MAP
PHASE I - BUILDING X PROJECT
REDMOND, WASHINGTON

DESIGN	DRAWN	PROJECT
KM	KM	1732
SCALE		
NTS		
DATE		
10-10-2019		
REVISED		

3

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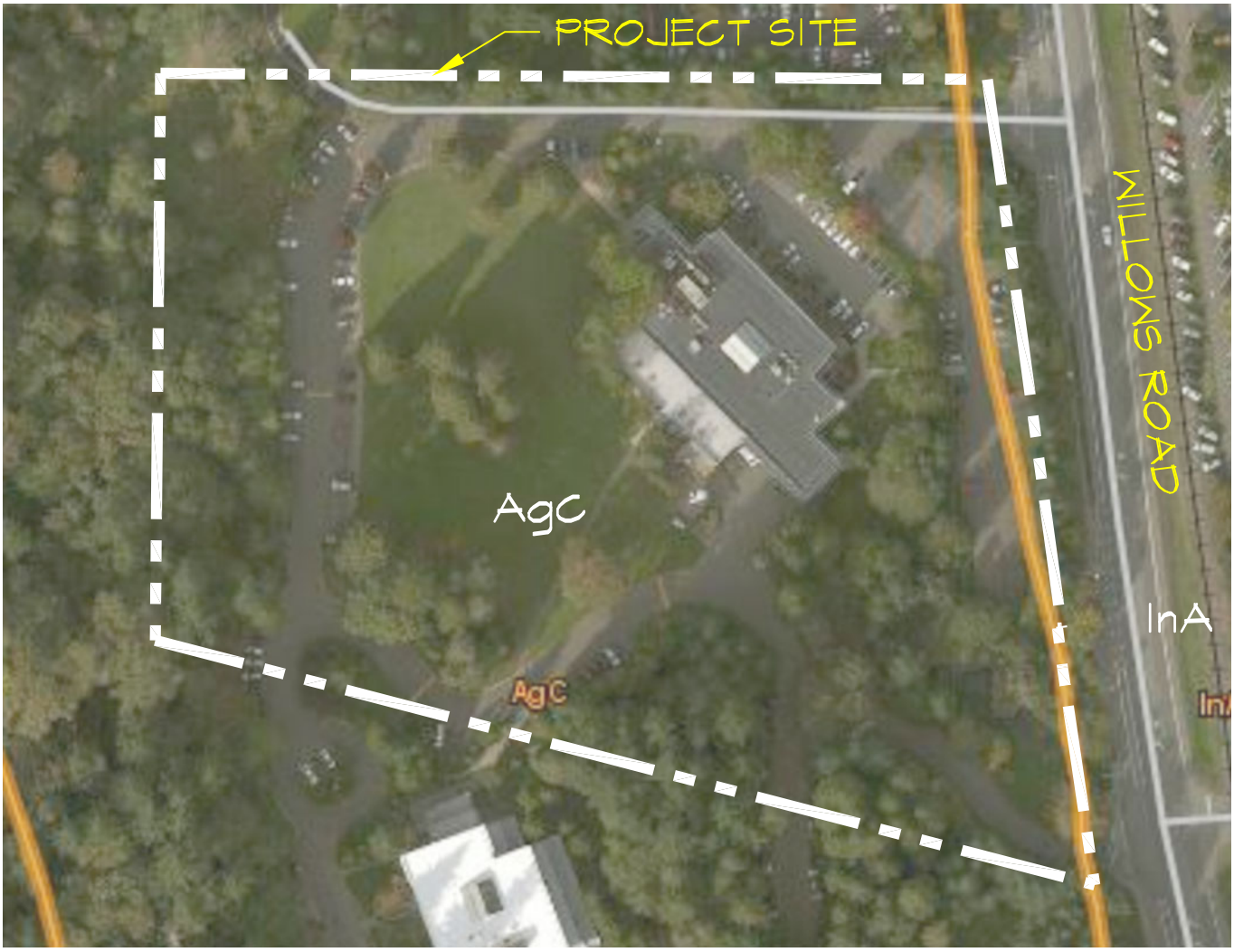
SE 1/4 SEC. 34, TWP. 26N, RGE. 5E, W.M.



LEGEND

TYPE	DESCRIPTION, SLOPES
AgC	ALDERWOOD GRAVELLY SANDY LOAM, 8-15% SLOPES.
InA	INDIANOLA LOAMY SAND, 0-5% SLOPES.

SOURCE: SOIL SURVEY STAFF, NATURAL RESOURCES CONSERVATION SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE, WEB SOIL SURVEY. AVAILABLE ONLINE AT http://websoilsurvey.nrcs.usda.gov/. ACCESSED (12 JUNE 2018).

NRCS FIGURE LAYERS

SOIL MAP UNIT BOUNDARY

NORTH

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15020 Bear Creek Road Northeast
Woodinville, Washington 98077
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FIGURE #4

NRCS SOILS MAP
PHASE I - BUILDING X PROJECT
REDMOND, WASHINGTON

DESIGN	DRAWN	PROJECT
KM	KM	1732
SCALE		
NTS		
DATE		4
10-10-2019		
REVISED		

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SE 1/4 SEC. 34, TWP. 26N, RGE. 5E, W.M.

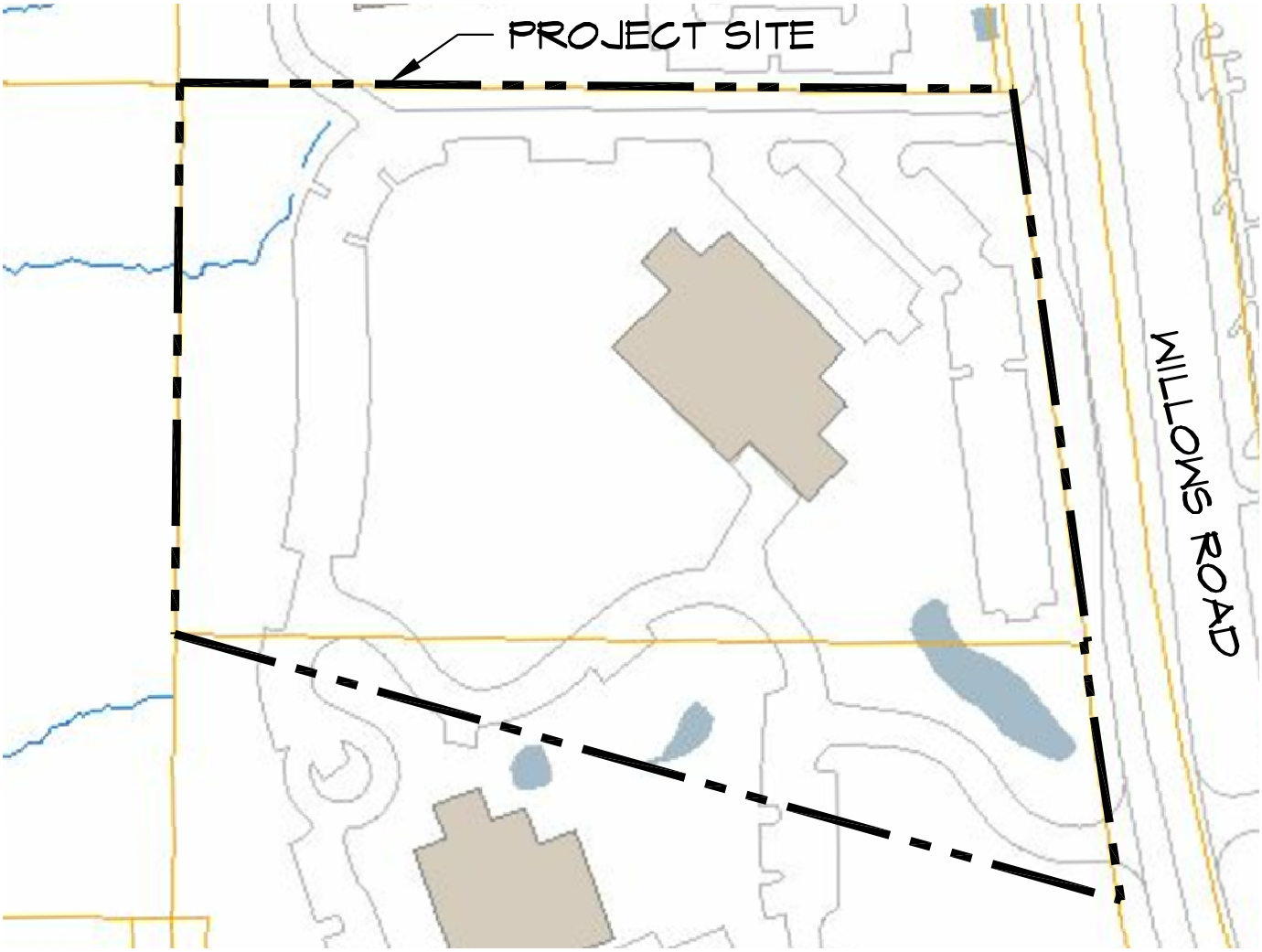

IMAGE SOURCE: CITY OF REDMOND GIS DATA (2018)

LEGEND

STREAM/RIVERS

PONDS

NORTH

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Woodinville, Washington 98077
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FIGURE #5

CITY OF REDMOND GIS DATABASE
PHASE I - BUILDING X PROJECT
REDMOND, WASHINGTON

DESIGN	DRAWN	PROJECT
KM	KM	1732
SCALE		
NTS		
DATE		
10-10-2019		
REVISED		

5

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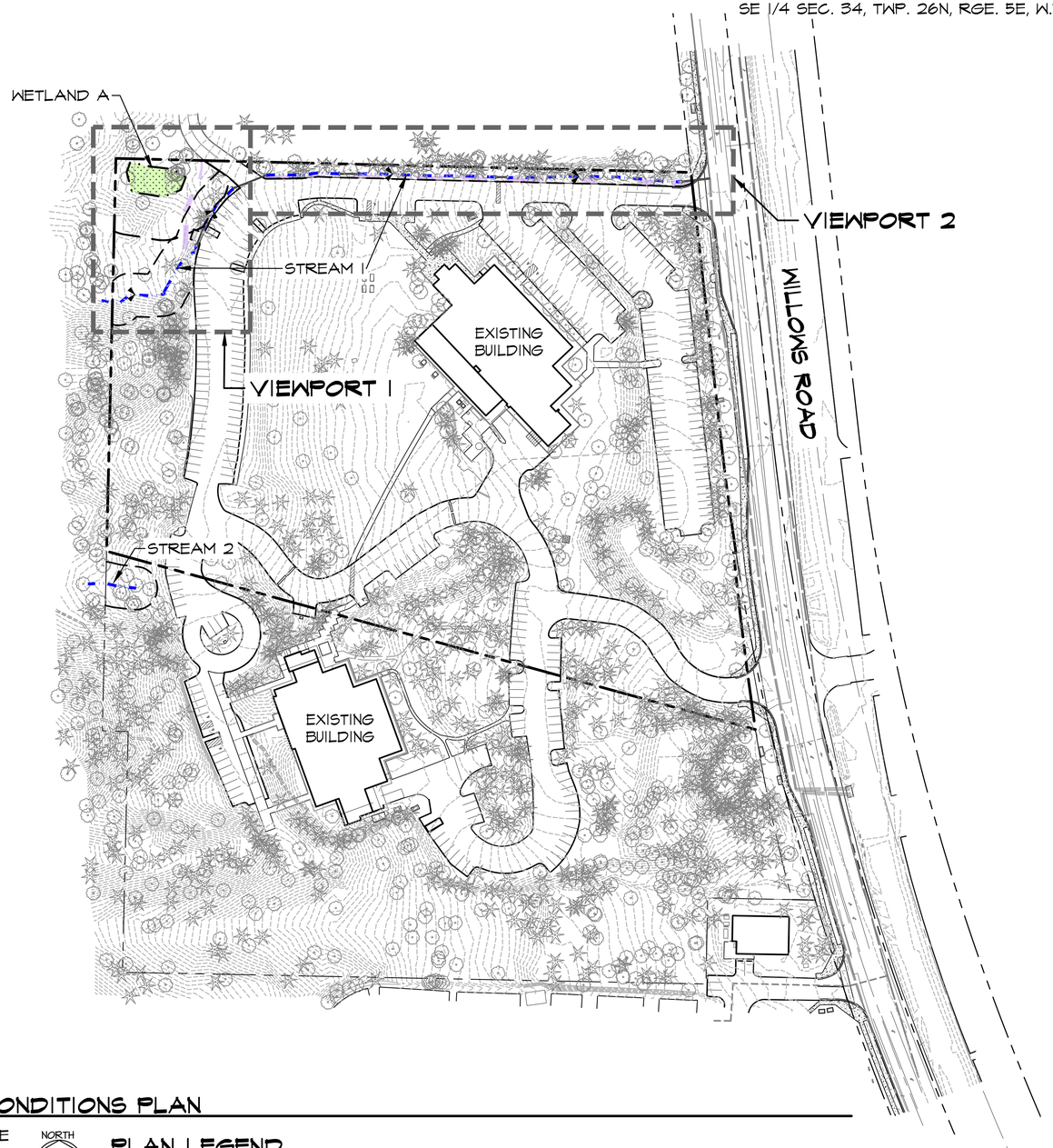
Appendix A:

Detailed Mitigation Plan Sheets (Full Size)



EXISTING CONDITIONS PLAN

GRAPHIC SCALE (IN FEET)
0 40 80 160
SCALE: 1"=80'

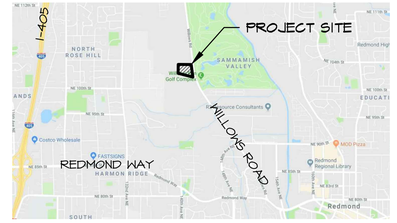
NORTH

PLAN LEGEND

- PROPERTY LINE
- EXISTING WETLAND
- WETLAND BUFFER
- STREAM BUFFER
- EXISTING STREAM CENTERLINE
- EXISTING CONTOUR
- EXISTING TREES

VICINITY MAP

NTS



SOURCE: GOOGLE MAPS; WWW.MAPS.GOOGLE.COM (ACCESSED 8/1/2018)

NORTH

CONTACTS

APPLICANT/OWNER

NAME:	WILLOW RUN, LLC
ADDRESS:	251 LITTLE FALLS DRIVE WILMINGTON, DE 19808
PHONE:	(650) 313-4821
CONTACT:	RORY O'BRIEN

SURVEYOR

NAME:	BUSH, ROED & HITCHINGS, INC.
ADDRESS:	2009 MINOR AVENUE EAST SEATTLE, WA 98102
PHONE:	(206) 323-4144
CONTACT:	DAKIN BELL, PLS

ENGINEER

NAME:	COUGHLIN PORTER LUNDEEN, INC.
ADDRESS:	801 SECOND AVENUE SUITE 900 SEATTLE, WA 98104
PHONE:	(206) 343-0460
CONTACT:	BART BALKO, P.E., LEED AP

ENVIRONMENTAL CONSULTANT

NAME:	TALASAEA CONSULTANTS, INC.
ADDRESS:	15020 BEAR CREEK RD. NE WOODINVILLE, WA 98077
PHONE:	(425) 861-7550
CONTACT:	ANN OLSEN, SENIOR PROJECT MANAGER DAVID TEESDALE, PWS SENIOR WETLAND ECOLOGIST

SHEET INDEX

SHEET NUMBER	SHEET TITLE
W1.0	EXISTING CONDITIONS PLAN
W1.1	EXISTING CONDITIONS PLAN
W1.2	PROPOSED SITE PLAN, IMPACTS & MITIGATION PLAN OVERVIEW PLAN
W1.3	CRITICAL AREA BUFFERS PLAN
W2.0	PROPOSED GRADING PLAN & DETAILS
W2.1	STREAM PROFILES
W2.2	GRADING SPECIFICATIONS
W2.3	GRADING SPECIFICATIONS & DETAILS
W3.0	PLANTING PLAN, PLANT SCHEDULE, NOTES & DETAILS
W4.0	PLANTING SPECIFICATIONS

THIS DEVELOPMENT SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE CITY OF REDMOND STANDARD SPECIFICATIONS AND DETAILS, CURRENT EDITION.

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NOTES

1. SURVEY PROVIDED BY BRH, INC., 2009 MINOR AVENUE EAST SEATTLE, WA 98102, (206) 323-4144.
2. SITE PLAN PROVIDED BY CPL, INC., 801 SECOND AVENUE, SUITE 900, SEATTLE, WA 98104, (206) 343-0460.
3. SOURCE DRAWING WAS MODIFIED BY TALASAEA CONSULTANTS FOR VISUAL ENHANCEMENT.
4. THIS PLAN IS AN ATTACHMENT TO THE CRITICAL AREAS REPORT PREPARED BY TALASAEA CONSULTANTS IN OCTOBER, 2019.

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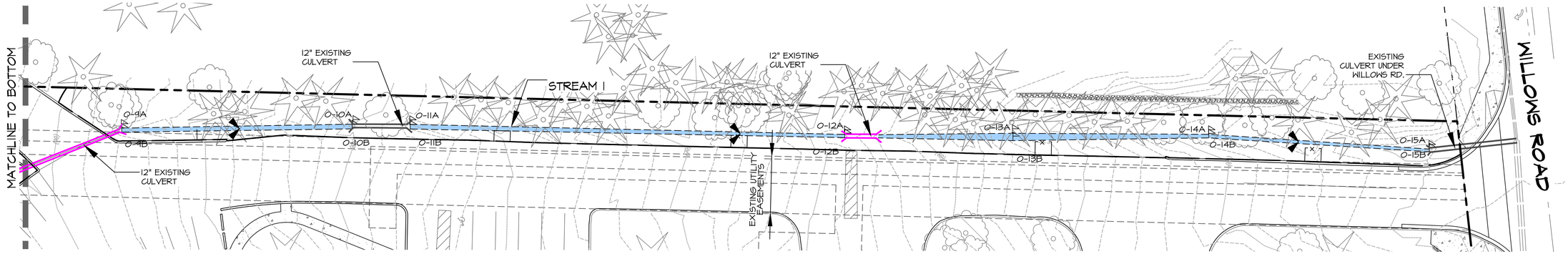
CRITICAL AREAS DETAILED MITIGATION PLAN
EXISTING CONDITIONS PLAN
BUILDING X PROJECT
REDMOND, WASHINGTON

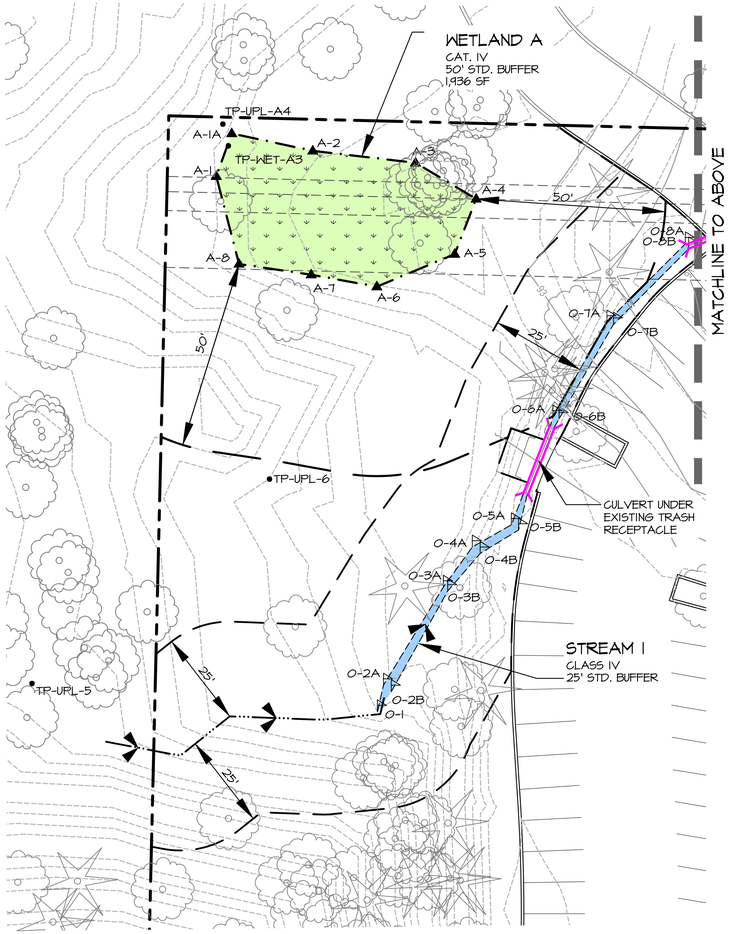
Revisions	Date	By
CITY COMMENTS	6-5-2019	FH
CITY COMMENTS	10-10-2019	MH
SITE PLAN ENTITLEMENT	10-18-2019	MH

Date	2-6-2019
Scale	AS SHOWN
Designed	AO
Drawn	MH/FH
Checked	AO
Approved	BS
Project #	1732
Sheet #	W1.0

SE 1/4 SEC. 34, TWP. 26N, RGE. 5E, W.M.



VIEWPORT 2



VIEWPORT 1

GRAPHIC SCALE
(IN FEET)
0 10 20 40
SCALE: 1"=20'

NORTH

PLAN LEGEND

- PROPERTY LINE
- EXISTING WETLAND
- WETLAND BUFFER
- ▲WL-# WETLAND FLAG LOCATION
- ●TP-# TEST PIT LOCATION
- STREAM ORDINARY HIGH WATER MARK (OHWM)
- STREAM CENTERLINE (ESTIMATED FROM TOPOGRAPHY)
- EXISTING CULVERT
- STREAM BUFFER
- O-# OHWM FLAG LOCATION
- EXISTING UTILITY EASEMENT
- EXISTING CONTOUR
- EXISTING TREES

NOTE: SEE SHEET W2.1 FOR EXISTING AND PROPOSED STREAM PROFILES

THIS DEVELOPMENT SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE CITY OF REDMOND STANDARD SPECIFICATIONS AND DETAILS, CURRENT EDITION.

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CRITICAL AREAS DETAILED MITIGATION PLAN
EXISTING CONDITIONS PLAN
BUILDING X PROJECT
REDMOND, WASHINGTON

Revisions	Date	By
CITY COMMENTS	6-5-2019	FH
CITY COMMENTS	10-10-2019	MW
SITE PLAN ENTITLEMENT	10-18-2019	MW

Date	2-6-2019
Scale	AS SHOWN
Designed	AO
Drawn	MW/FH
Checked	AO
Approved	BS
Project #	1732
Sheet #	W1.1

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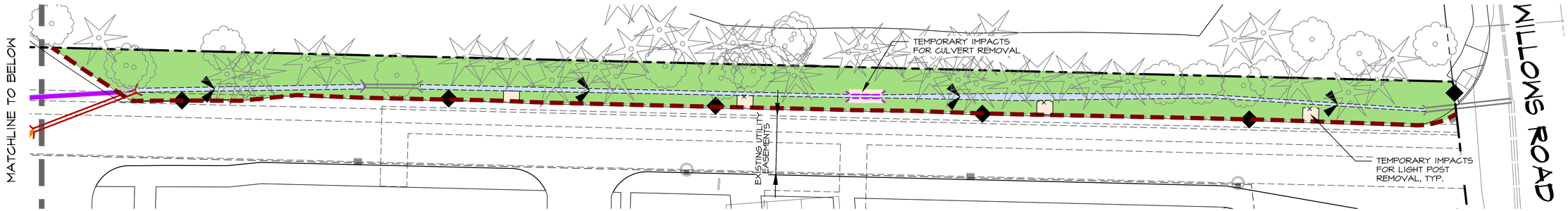
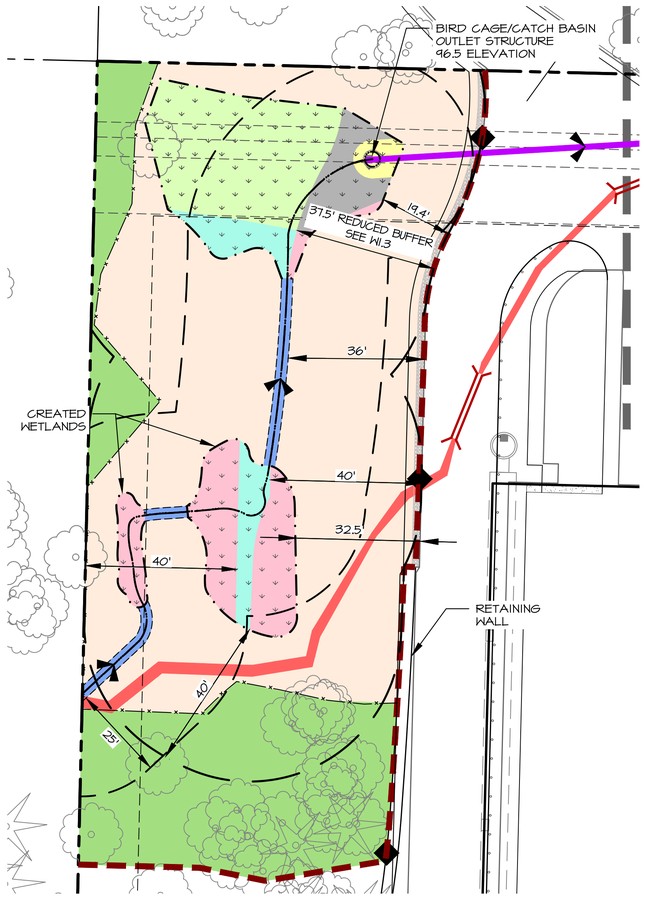
SE 1/4 SEC. 34, TWP. 26N, RGE. 5E, W.M.



PROPOSED SITE PLAN, IMPACTS & MITIGATION PLAN



IMPACTS LEGEND

FILLED OPEN STREAM CHANNEL	195 LF
CULVERT TO BE REMOVED	59 LF
TEMPORARY STREAM IMPACTS FOR STREAM DAYLIGHTING	11 LF
WETLAND AS BUFFER	359 SF
TEMPORARY WETLAND AS BUFFER CONSTRUCTION IMPACTS	109 SF
TEMPORARY BUFFER CONSTRUCTION IMPACTS	10,576 SF

MITIGATION LEGEND

PRESERVED STREAM CHANNEL

EXISTING OPEN CHANNEL TO BE PRESERVED	453 LF
EXISTING CULVERT TO BE MAINTAINED	31 LF

RELOCATED STREAM CHANNEL

NEW OPEN CHANNEL	194 LF
DAYLIGHT/CULVERT REMOVAL	11 LF

CULVERT EXTENSION

PROPOSED CULVERT EXTENSION	102 LF
TOTAL PROPOSED STREAM LENGTH:	791 LF
NET GAIN:	42 LF

CRITICAL AREA MITIGATION

WETLAND & STREAM BUFFER

WETLAND CONVERTED TO BUFFER

ENHANCED WETLAND AS BUFFER	359 SF
RESTORED WETLAND AS BUFFER	109 SF
TOTAL WETLAND REPLACEMENT AREA	468 SF

TO USE FOR RZC 21.64.030.C.8.d BY APPLYING RZC 21.64.030.C.7.c AND RZC 21.64.030.C.7.d

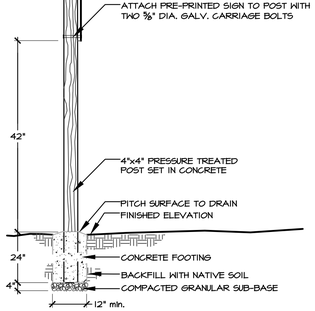
ENHANCED WETLAND & STREAM BUFFER	12,104
RESTORED WETLAND & STREAM BUFFER	10,576 SF

WETLAND

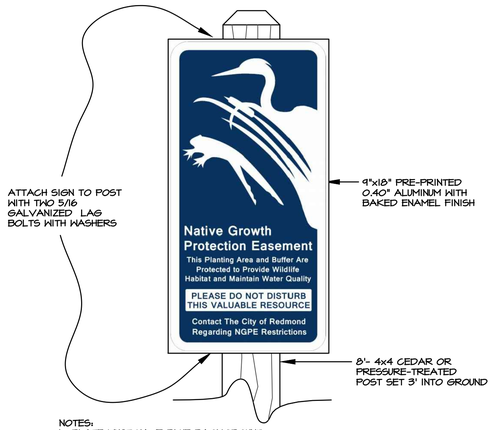
ENHANCED WETLAND	1,469 SF
FOR RZC 21.64.030.C.8.d FOR WETLAND REPLACEMENT AREA (ABOVE) RATIO PER REQUIRED IN TABLE 21.64.030.B	>2:1
COMPENSATORY WETLAND CREATION	490 SF
FOR RZC 21.64.030.C.8.d FOR WETLAND REPLACEMENT AREA (ABOVE) RATIO PER REQUIRED IN TABLE 21.64.030B	>1:1
NON-COMPENSATORY WETLAND CREATION	1,098 SF
TOTAL MITIGATION AREA:	26,205 SF

CRITICAL AREA SIGN (1/M1.2)

POST CONSTRUCTION BUFFER/CRITICAL AREA FENCE (2/M1.2)

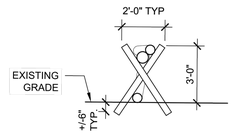


1 CRITICAL AREA SIGN
N.T.S.

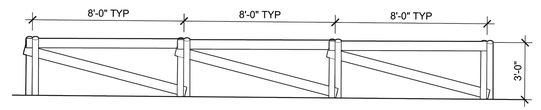


NOTES:
1. PLATE MUST HAVE BLUE BACKGROUND.
2. THE WETLAND/STREAM SIGN SHALL BE POSTED AT THE BOUNDARY BETWEEN THE SENSITIVE AREA BUFFER, SETBACK AREA OR SETBACK TRACT AND THE BUILDING SETBACK AREA.
3. ONE SIGN SHALL BE POSTED FOR EVERY 100-FEET OF SENSITIVE AREA BUFFER AND SHALL BE STATIONED IN A PROMINENT LOCATION, i.e.: AT THE CLOSEST POINT TO THE PROPOSED DEVELOPMENT. SIGNS MAY ALSO BE ATTACHED TO FENCES.
4. SIGNS SHALL MEET ALL CRITICAL AREA SIGN SPECIFICATIONS SET FORTH BY THE CITY OF REDMOND.
5. IF FURTHER ASSISTANCE IS REQUIRED, E-MAIL PLANNERONCALL@REDMOND.GOV OR PHONE 425-556-2444

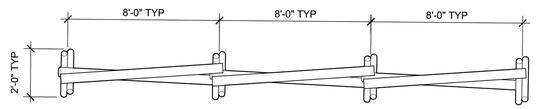
2 CITY OF REDMOND NGPE SIGN DETAIL
N.T.S.



CRITICAL AREA FENCE: SECTION
3 N.T.S.



4 CRITICAL AREA FENCE: ELEVATION
N.T.S.



5 CRITICAL AREA FENCE: PLAN
N.T.S.

THIS DEVELOPMENT SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE CITY OF REDMOND STANDARD SPECIFICATIONS AND DETAILS, CURRENT EDITION.

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NOTES

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PROPOSED SITE PLAN, IMPACTS & MITIGATION PLAN

GRAPHIC SCALE (IN FEET)
0 10 20 40
SCALE: 1"=20'

NORTH

PLAN LEGEND

- PROPERTY LINE
- POST-CONSTRUCTION WETLANDS
- STANDARD WETLAND BUFFER
- STANDARD STREAM BUFFER
- CLEARING LIMITS
- EXISTING TREES TO REMAIN (DECIDUOUS - CONIFER)

TALASAEA CONSULTANTS, INC.
Resource & Environmental Planning
10020 Bear Creek Road Northeast - Woodinville, Washington 98077
Bus (425) 861-7500 - Fax (425) 861-7549

CRITICAL AREAS DETAILED MITIGATION PLAN
PROPOSED SITE PLAN, IMPACTS AND MITIGATION PLAN
BUILDING X PROJECT
REDMOND, WASHINGTON

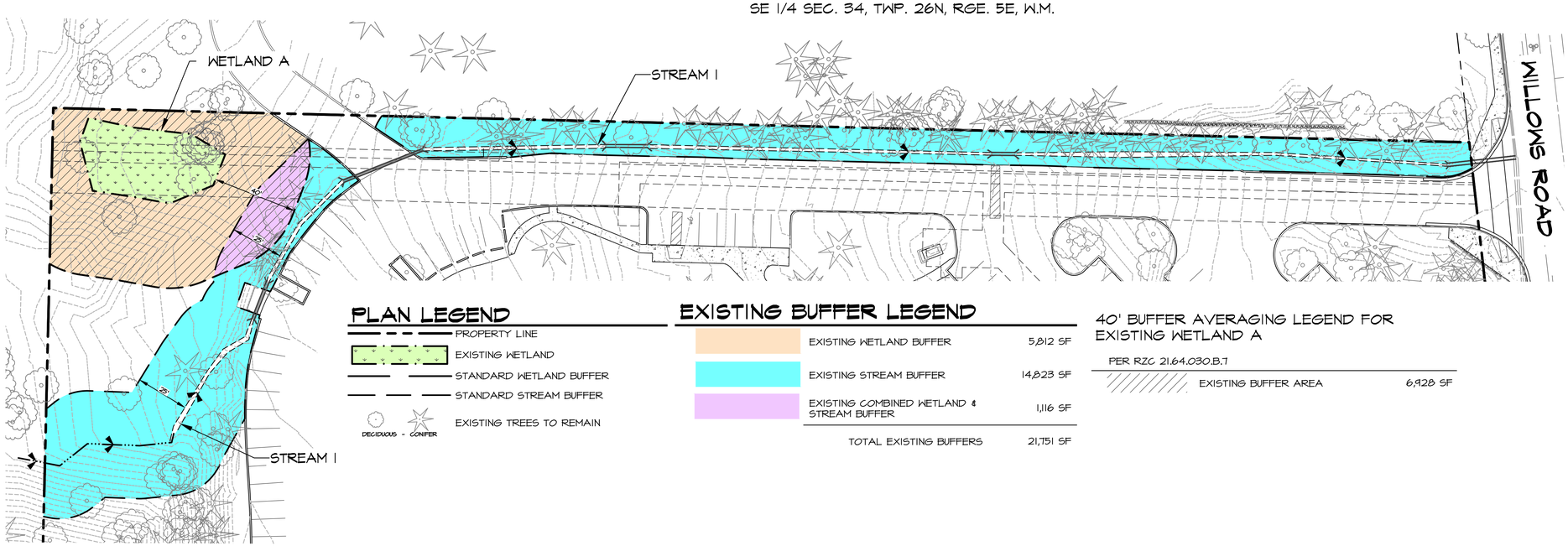
Revisions	Date	By
CITY COMMENTS	6-5-2019	FH
CITY COMMENTS	10-10-2019	MW
SITE PLAN ENTITLEMENT	10-18-2019	MW

Date	2-6-2019
Scale	AS NOTED
Designed	AO
Drawn	MW/FH
Checked	AO
Approved	BS

Project # 1732

Sheet # M1.2

SE 1/4 SEC. 34, TWP. 26N, RGE. 5E, W.M.



PLAN LEGEND

- PROPERTY LINE
- EXISTING WETLAND
- STANDARD WETLAND BUFFER
- STANDARD STREAM BUFFER
- EXISTING TREES TO REMAIN (DECIDUOUS - CONIFER)

EXISTING BUFFER LEGEND

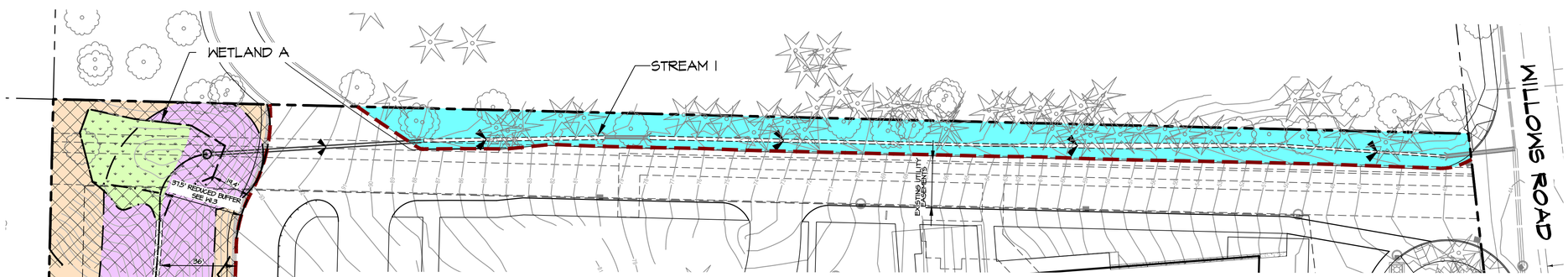
EXISTING WETLAND BUFFER	5,812 SF
EXISTING STREAM BUFFER	14,823 SF
EXISTING COMBINED WETLAND & STREAM BUFFER	1,116 SF
TOTAL EXISTING BUFFERS	21,751 SF

40' BUFFER AVERAGING LEGEND FOR EXISTING WETLAND A

PER RZC 21.64.030.B.1

EXISTING BUFFER AREA	6,928 SF

EXISTING BUFFERS



PLAN LEGEND

- PROPERTY LINE
- POST-CONSTRUCTION WETLANDS
- STANDARD WETLAND BUFFER
- STANDARD STREAM BUFFER
- EXISTING TREES TO REMAIN (DECIDUOUS - CONIFER)

PROPOSED BUFFER LEGEND

PROPOSED WETLAND BUFFER	7,715 SF
PROPOSED STREAM BUFFER	7,643 SF
PROPOSED COMBINED WETLAND & STREAM BUFFER	8,728 SF
TOTAL PROPOSED BUFFERS	24,086 SF

37.5' REDUCED BUFFER FOR 40' BUFFER AVERAGING LEGEND FOR EXISTING WETLAND A

PER RZC 21.64.030.B.1

BUFFER AVERAGE AREA	8,481 SF

* COMPARE TO 6,928 SF EXISTING 40' BUFFER AREA ABOVE

PROPOSED BUFFERS

GRAPHIC SCALE (IN FEET)

0 15 30 60

SCALE: 1"=30'

NORTH

THIS DEVELOPMENT SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE CITY OF REDMOND STANDARD SPECIFICATIONS AND DETAILS, CURRENT EDITION.

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NOTES

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CRITICAL AREA BUFFERS PLAN
BUILDING X PROJECT
REDMOND, WASHINGTON

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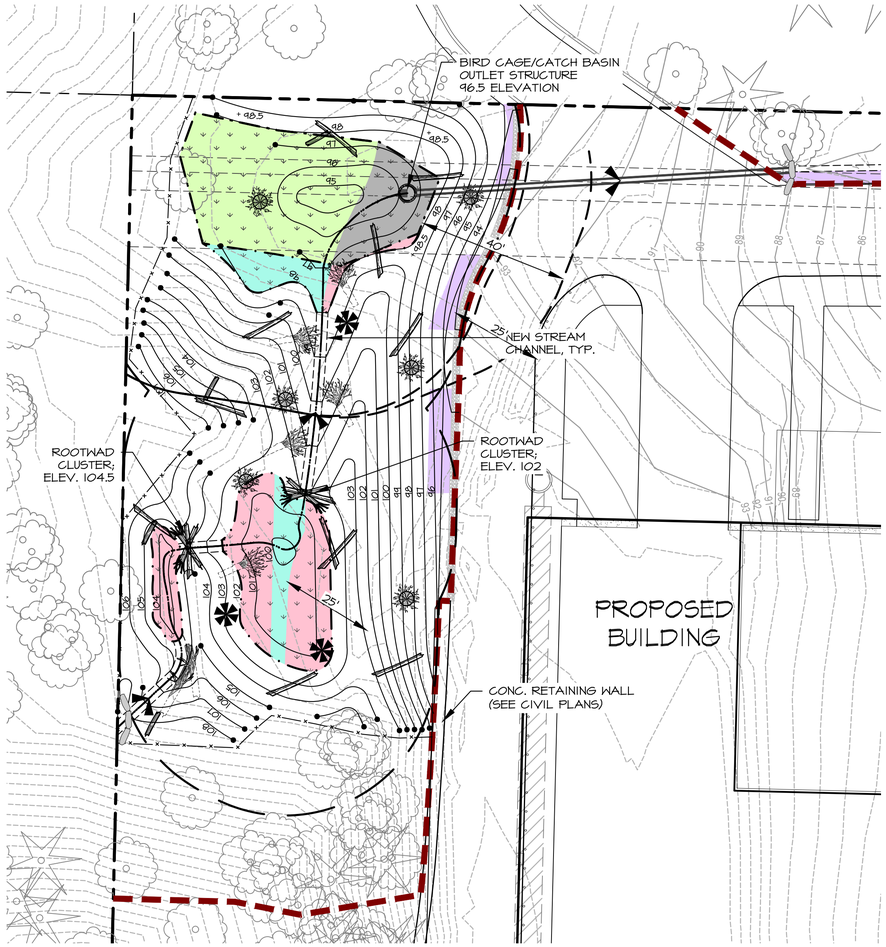
Sheet # W1.3

SE 1/4 SEC. 34, TWP. 26N, RGE. 5E, W.M.



PROPOSED GRADING PLAN

GRAPHIC SCALE (IN FEET)
0 10 20 40
SCALE: 1"=20'

NORTH

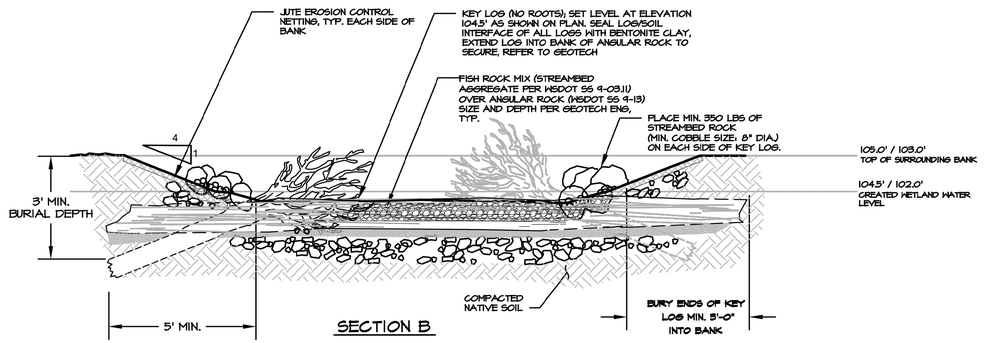
PLAN LEGEND

- PROPERTY LINE
- EXISTING WETLAND
- EXISTING WETLAND AS BUFFER
- COMPENSATORY WETLAND CREATION
- NON-COMPENSATORY WETLAND CREATIOI
- STREAM CENTERLINE
- STREAM ORDINARY HIGH WATER MARK (OHWM)
- CLEARING LIMITS
- POST CONSTRUCTION BUFFER/CRITICAL AREA FENCE
- 100 PROPOSED CONTOUR
- DECIDUOUS - CONIFER EXISTING TREES TO REMAIN

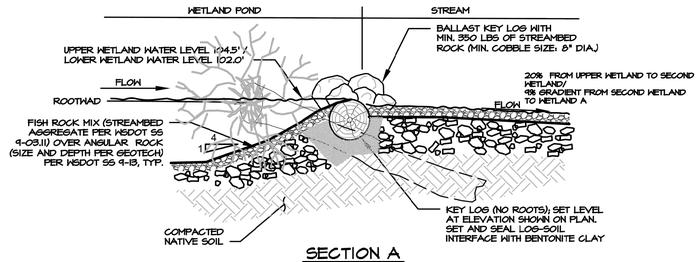
HABITAT LEGEND

- SNAG W/ SWALLOW NEST BOX (2 #2.2)
- WOODY DEBRIS (LONG & SHORT DOWN LOGS) (3 #2.2)
- STUMP (SET UPRIGHT) (3 #2.2)
- DEFLECTOR LOG *
- BURIED ROOTWAD (LAYING ON SIDE *
- SANDBAG DAM FOR TEMPORARY STREAM FLOW BY PASS (2 #2.2)
- ROOTWAD CLUSTER (1 #2.2)

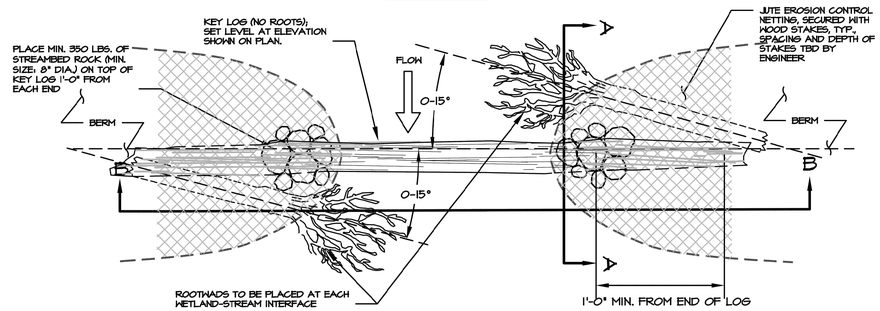
* NOTE: GEOTECHNICAL ENGINEER TO PROVIDE SPECIFICATIONS FOR BURYING DEFLECTOR LOGS & ROOTWADS IN STREAM BANK.



SECTION B



SECTION A



INSTALLATION NOTES:

1. WATER LEVEL CONTROL STRUCTURE SHALL BE INSTALLED WHERE SHOWN ON GRADING PLAN.
2. PACK BENTONITE AROUND LOG/SOIL INTERFACE OF ALL LOGS TO PREVENT SEEPAGE AND EROSION AROUND LOGS.
3. SECURE EACH KEY LOG BY BURYING ENDS INTO BERM SLOPES AND ANCHOR WITH SMALL BOULDERS.
4. STABILIZE BERM SLOPES ADJACENT TO KEY LOG WITH JUTE EROSION CONTROL NETTING AND MULCH.
5. MINIMUM KEY LOG LENGTH: 12 FEET
   MINIMUM KEY LOG DIAMETER: 12 INCHES
6. MINIMUM ROOTWAD STEM LENGTH: 8 FEET
   MINIMUM ROOTWAD STEM DIAMETER: 10 INCHES
   LOG SPECIES: WESTERN RED CEDAR
7. DEPTHS, ANGLES AND EXTENT OF ROOTWAD STEMS AND KEY LOG PLACEMENTS AS SHOWN.

(1) WATER LEVEL CONTROL DETAIL

SCALE: NTS

THIS DEVELOPMENT SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE CITY OF REDMOND STANDARD SPECIFICATIONS AND DETAILS, CURRENT EDITION.

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CRITICAL AREAS DETAILED MITIGATION PLAN
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REDMOND, WASHINGTON

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Project # 1732

Sheet # W2.0

Z:\DRAWING\1700-1799\TAL1732\PLANS\TAL-1732 WP-REBUILD (2019-10-11).DWG
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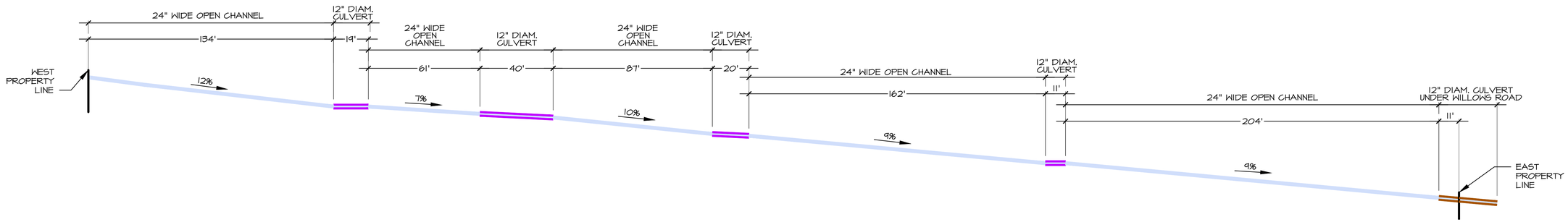
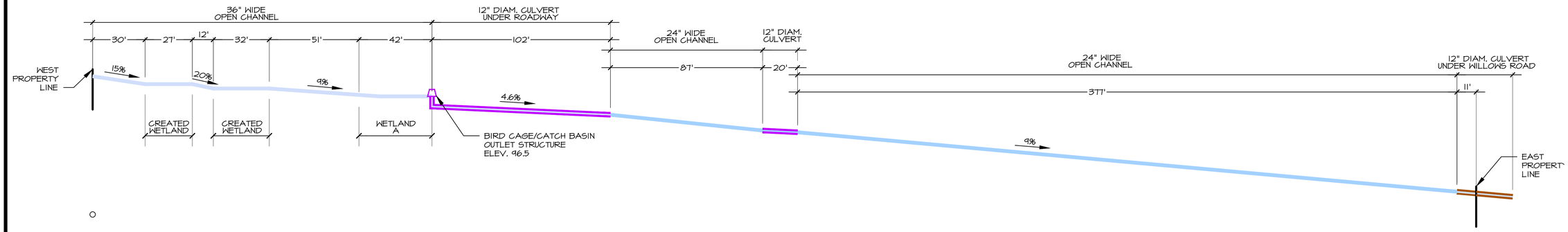


STREAM PROFILE: CURRENT

SCALE: 1"=30'



STREAM PROFILE: PROPOSED

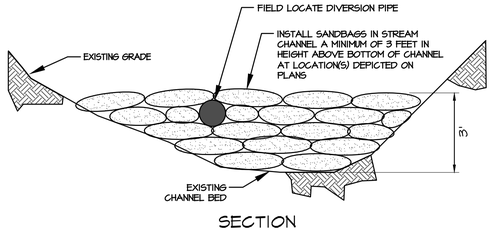
SCALE: 1"=30'

STREAM PROFILE: CURRENT

	EXISTING OPEN CHANNEL	648 LF
	EXISTING STREAM IN CULVERTS	101 LF
	TOTAL STREAM LENGTH (ON-SITE)	749 LF

STREAM PROFILE: PROPOSED

	OPEN CHANNEL	658 LF
	STREAM IN CULVERTS	133 LF
	TOTAL STREAM LENGTH (ON-SITE)	791 LF



SECTION

NOTE: CONTRACTOR SHALL DETERMINE BYPASS ROUTE TO GUARANTEE POSITIVE GRAVITY FLOW AROUND CONSTRUCTION AREA.

TEMPORARY BYPASS INSTALLATION GUIDELINES:

1. ALL WORK WITHIN THE ORDINARY HIGH WATER LINE (OHWL) OF THE STREAM SHALL BE DONE IN ACCORDANCE WITH AN APPROVED HYDRAULIC PROJECT APPROVAL (HPA).
2. FOR WORK LOCATED WITHIN THE OHWL OF THE STREAM CHANNEL, THE WORK AREA SHALL BE ISOLATED FROM THE WETTED PERIMETER BY A TEMPORARY BYPASS TO DIVERT FLOWS AROUND THE WORK AREA AND TO PREVENT SEDIMENTS FROM ENTERING THE STREAM.
3. THE TEMPORARY BYPASS SHALL BE IN PLACE PRIOR TO INITIATION OF WORK WITHIN THE OHWL OF THE STREAM.
4. A SANDBAG DAM SHALL BE INSTALLED AT THE BYPASS INLET . THE DAM SHALL BE LOCATED A MINIMUM OF 20 FEET UPSTREAM OF WORK AREA (see locations on Sheet W2.0).
5. ONCE THE BYPASS IS IN PLACE, THE CONTRACTOR SHALL INSTALL A SUMP PUMP TO DIVERT THE ENTIRE FLOW THROUGH THE BYPASS, AROUND THE WORK AREA, FOR THE DURATION OF CONSTRUCTION.
6. THE UPSTREAM BYPASS SHALL BE OF SUFFICIENT SIZE TO PASS ALL FLOWS AND DEBRIS FOR THE DURATION OF EXCAVATION IN THE STREAM CHANNEL.
7. A SECOND SANDBAG DAM SHALL BE INSTALLED AT THE DOWNSTREAM END OF THE BYPASS TO PREVENT BACKWATER FROM ENTERING THE WORK AREA.
8. PRIOR TO RELEASING THE STREAM FLOW THROUGH THE COMPLETED PROJECT AREA, THE BANKS AND STREAMBED SHALL BE STABILIZED, i.e., STREAMBANKS SEEDED AND PLANTED AND ROCK MIX PLACED IN REGRADED CHANNEL.
9. UPON COMPLETION OF THE PROJECT, ALL MATERIAL USED IN THE TEMPORARY BYPASS SHALL BE REMOVED FROM THE SITE AND THE SITE SHALL BE RETURNED TO PRE-PROJECT OR IMPROVED CONDITIONS.

1 TEMPORARY BYPASS - SANDBAG DAM DETAIL, TYP.

N.T.S.

THIS DEVELOPMENT SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE CITY OF REDMOND STANDARD SPECIFICATIONS AND DETAILS, CURRENT EDITION.

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CRITICAL AREAS DETAILED MITIGATION PLAN
STREAM PROFILES
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REDMOND, WASHINGTON

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Project # 1732

Sheet # W2.1

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GRADING SPECIFICATIONS

PART 1: GENERAL

1.1 SEQUENCING

A. GENERAL CONSTRUCTION:

1. NOTICE TO PROCEED: CONTRACTOR SHALL GIVE TALASAEA CONSULTANTS A MINIMUM OF TEN (10) DAYS NOTICE PRIOR TO BEGINNING CONSTRUCTION. A QUALIFIED WETLAND CONSULTANT SHALL BE ON SITE, AS NECESSARY, TO MONITOR CONSTRUCTION AND APPROVE MINOR REVISIONS TO THE PLAN.
2. PRE-CONSTRUCTION MEETING: NO CONSTRUCTION WORK SHALL COMMENCE UNTIL THERE IS A MEETING BETWEEN THE CLIENT, TALASAEA CONSULTANTS, GENERAL, CLEARING, AND/OR EARTHWORK CONTRACTORS, AND THE LANDSCAPE CONTRACTOR. THE APPROVED PLANS AND SPECIFICATIONS SHALL BE REVIEWED TO ENSURE THAT ALL PARTIES INVOLVED UNDERSTAND THE INTENT AND THE SPECIFIC DETAILS RELATED TO THE CONSTRUCTION DOCUMENTS, SPECIFICATIONS AND SITE CONSTRAINTS.
3. LOCATIONS OF EXISTING UTILITIES HAVE BEEN ESTABLISHED BY FIELD SURVEY OR OBTAINED FROM AVAILABLE RECORDS AND SHOULD BE CONSIDERED APPROXIMATE ONLY AND NOT NECESSARILY COMPLETE. IT IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR TO: (1) INDEPENDENTLY VERIFY THE ACCURACY OF UTILITY LOCATIONS AND (2) DISCOVER AND AVOID ANY UTILITIES WITHIN THE MITIGATION PLAN AREA(S) THAT ARE NOT SHOWN, BUT WHICH MAY BE AFFECTED BY IMPLEMENTATION OF THE PLAN. SUCH AREA(S) ARE TO BE CLEARLY MARKED IN THE FIELD. TALASAEA CONSULTANTS SHALL REVIEW ANY CONFLICTS WITH THE APPROVED GRADING PLAN PRIOR TO START OF CONSTRUCTION.
4. A COPY OF THE APPROVED PLANS MUST BE ON SITE WHENEVER CONSTRUCTION IS IN PROGRESS, AND SHALL REMAIN ON SITE UNTIL PROJECT COMPLETION.
5. CONSTRUCTION MUST BE PERFORMED IN ACCORDANCE WITH ALL AGENCY STANDARDS, RULES, CODES, PERMIT CONDITIONS, AND/OR OTHER APPLICABLE ORDINANCES AND POLICIES.
6. WORK BELOW THE ORDINARY HIGH WATER LINE SHALL OCCUR WITHIN THE AUTHORIZED WINDOW OF THE HPA AND OTHER PERMITS.
7. THE PROJECT OWNER/APPLICANT IS RESPONSIBLE FOR OBTAINING ANY OTHER RELATED OR REQUIRED PERMITS PRIOR TO THE START OF CONSTRUCTION.
8. A QUALIFIED WETLAND CONSULTANT SHALL BE ON SITE, AS NECESSARY, TO MONITOR CONSTRUCTION AND APPROVE MINOR REVISIONS TO THE PLAN.
9. TOPOGRAPHIC ELEVATIONS REPRESENTED ON MITIGATION PLANS ARE BASED UPON TOPOGRAPHIC MAPS SUPPLIED BY THE SURVEYOR. FINAL ELEVATIONS MAY VARY DEPENDING ON SITE-SPECIFIC CONDITIONS. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY PRE-CONSTRUCTION TOPOGRAPHIC ELEVATIONS FOR ACCURACY PRIOR TO GRADING. CONTRACTOR SHALL NOTIFY TALASAEA CONSULTANTS IMMEDIATELY IF ANY MODIFICATIONS TO THE PLANS MAY BE NECESSARY DUE TO INACCURACIES OF THE ORIGINAL SURVEY.
10. DURING CONSTRUCTION, THE CONTRACTOR MUST USE MATERIALS AND CONSTRUCTION METHODS THAT PREVENT TOXIC SUBSTANCES AND OTHER POLLUTANTS FROM ENTERING MITIGATION AREAS OR OTHER NATURAL WATERS OF THE STATE.
11. PREVENTATIVE MEASURES SHALL BE USED TO PROTECT EXISTING STORM DRAINAGE SYSTEMS, EXISTING UTILITIES, AND ROADS.
12. THE CONTRACTOR SHALL PROVIDE SEDIMENT AND EROSION CONTROLS AROUND THE PROJECT AREA PRIOR TO SOIL DISTURBANCE FROM CONSTRUCTION ACTIVITY.

B. MITIGATION CONSTRUCTION: THE FOLLOWING PROVIDES THE GENERAL SEQUENCE OF ACTIVITIES ANTICIPATED TO BE NECESSARY TO COMPLETE THIS MITIGATION PROJECT. SOME OF THESE ACTIVITIES MAY BE CONDUCTED CONCURRENTLY AS THE PROJECT PROGRESSES.

1. CONDUCT A SITE MEETING BETWEEN THE CONTRACTOR, TALASAEA CONSULTANTS, AND THE OWNER'S REPRESENTATIVE TO REVIEW THE PROJECT PLANS, STAGING/STOCKPILE AREAS, AND MATERIAL DISPOSAL AREAS.
2. COORDINATE WITH THE GENERAL CONTRACTOR TO ENSURE THAT REQUIRED UTILITY OR STORMWATER FACILITIES ARE COMPLETED WITHIN THE CRITICAL AREAS, PRIOR TO FINISHED GRADING.
3. SURVEY CLEARING LIMITS.
4. INSTALL SILT FENCE AND ANY OTHER EROSION AND SEDIMENTATION CONTROL BMPS NECESSARY FOR WORK IN THE PROJECT AREAS.
5. INSTALL TEMPORARY STREAM BYPASS AND SANDBAG DAMS.
6. CLEAR AND GRUB EARTHWORK AREAS, SALVAGING LARGE WOODY MATERIALS AS DIRECTED.
7. SURVEY EARTHWORK AREAS AND SET GRADE STAKES AS REQUIRED.
8. STRIP AND STOCKPILE ACCEPTABLE TOPSOIL FROM EXCAVATION AND FILL AREAS.
9. COMPLETE THE EXCAVATED MITIGATION AREAS TO ROUGH GRADE, USING ACCEPTABLE CLEAN FILL MATERIALS FROM THESE EXCAVATIONS TO CONCURRENTLY CONSTRUCT ANY EARTHEN BERMS SHOWN ON THE PLANS.
10. GRUB INVASIVE SPECIES BY HAND FROM ENHANCED EXISTING VEGETATED BUFFER AREAS.
11. INSTALL ALL IN-STREAM STRUCTURES, ROOTWAD CLUSTERS, DEFLECTOR LOGS & ROOTAWAD) INCLUDING FISH ROCK, AND SNAGS.
12. PLACE TOPSOIL TO FINISHED GRADES.
13. PLACE HABITAT FEATURES, INCLUDING; STUMPS AND AND DOWN LOGS.
14. MULCH ALL GRADED BUFFER AREAS.
15. COMPLETE SITE CLEANUP AND INSTALL PLANT MATERIAL AS INDICATED ON THE MITIGATION PLANS (SEE PLANTING SPECIFICATIONS).
16. INSTALL TEMPORARY IRRIGATION
17. INSTALL FENCING, CRITICAL AREA PROTECTION SIGNS, AND NESTING BOXES.
18. COMPLETE ALL WORK TO PLAN SPECIFICATION FOR APPROVAL BY TALASAEA CONSULTANTS.

1.2 PROJECT CONDITIONS

A. PROTECTION AND MAINTENANCE OF OFF-SITE AREAS: CONTRACTOR SHALL ENSURE THAT CONSTRUCTION RELATED ACTIVITIES DO NOT DAMAGE OFF-SITE FEATURES OR ADJACENT VEGETATION. TALASAEA CONSULTANTS SHALL BE NOTIFIED IMMEDIATELY IF ACCIDENTAL DAMAGE OCCURS. CONTRACTOR SHALL ENSURE THAT ADJACENT ROADS ARE MAINTAINED AND KEPT CLEAR OF SOIL AND/OR OTHER DEBRIS AT ALL TIMES DURING CONSTRUCTION. CONTRACTOR SHALL COMPLY WITH THE GOVERNING JURISDICTION'S CODES REGARDING STREET MAINTENANCE/CLEANING DURING CONSTRUCTION.

B. PLAN CHANGES AND MODIFICATIONS: ANY CHANGES OR MODIFICATIONS TO THE MITIGATION PLANS OR SPECIFICATIONS MUST RECEIVE PRIOR APPROVAL FROM THE OWNER'S REPRESENTATIVE, TALASAEA CONSULTANTS, AND APPLICABLE AGENCIES.

1.3 WARRANTY

A. WARRANTY TERMS AND CONDITIONS: A CONTRACTOR-PROVIDED WARRANTY SHALL EXTEND FOR A PERIOD OF ONE YEAR FROM THE DATE OF PHYSICAL COMPLETION. PHYSICAL COMPLETION FOR THE WORK OF THIS SECTION IS THE DATE WHEN ALL GRADING, PLANTING, IRRIGATION, AND RELATED PHASES OF SUCH WORK HAVE BEEN COMPLETED AND ARE ACCEPTED BY THE OWNER'S REPRESENTATIVE, TALASAEA CONSULTANTS, AND APPLICABLE AGENCIES. CONTRACTOR'S WARRANTY SHALL INCLUDE GRADING AND DRAINAGE CORRECTIONS.

PART 2: PRODUCTS AND MATERIALS

2.1 HABITAT FEATURES

A. SWALLON NESTING BOXES:

1. SWALLON NESTING BOXES SHALL BE CONSTRUCTED OF CEDAR OR CYPRESS.
2. CONTRACTOR MAY PURCHASE SWALLON NESTING BOXES AT:
   a. TALASAEA CONSULTANTS, (425) 861-7550 OR,
   b. SEATTLE AUDUBON SOCIETY, (206) 523-4483 OR,
   c. WILD BIRDS UNLIMITED, (206) 575-4001

B. SNAGS: SNAGS SHALL BE CEDAR OR FIR SPECIES, 24-53 FEET LONG, WITH A MINIMUM OF EIGHT MAIN BRANCHES, AND A MINIMUM DIAMETER OF 20 INCHES AT GROUND LEVEL AFTER INSTALLATION.

C. DOWN LOGS: DOWN LOGS SHALL BE CEDAR OR FIR SPECIES, HAVE A 20 FOOT MINIMUM LENGTH, WITH OR WITHOUT ROOTS, AND A MINIMUM DIAMETER OF 18 INCHES. BARK SHALL BE KEPT INTACT. ENDS THAT HAVE BEEN CUT SHALL BE DISTRESSED AND NOT BLUNT.

D. ROOTWADS: ROOTWADS SHALL HAVE 8 FEET OF TRUNK WITH ROOTS.

E. STUMPS: STUMPS SHALL BE EITHER PART-DECAYED, RELOCATED STUMPS, OR CUT LIVE ROOTWADS WITH A MINIMUM OF THREE FEET OF TRUNK 20 INCHES IN DIAMETER MINIMUM. ENDS THAT HAVE BEEN CUT SHALL BE DISTRESSED AND NOT BLUNT.

F. BOULDERS:

1. SALVAGE BOULDERS UNCOVERED FROM ON-SITE GRADING OPERATIONS, AS AVAILABLE FOR USE IN THE CRITICAL AREAS MITIGATION.
2. SALVAGED BOULDERS SHALL BE A MINIMUM SIZE OF ONE OR TWO-PERSON ROCK, WITH TWELVE INCHES MINIMUM WIDTH.
3. NOTIFY TALASAEA CONSULTANTS IF ROCKS ARE AVAILABLE, SO TALASAEA MAY PROVIDE DIRECTION IN LOCATIONS FOR PLACEMENT WITHIN THE WORK AREA.

2.2 IN-STREAM STRUCTURES

A. ROOTWADS CLUSTER: LOGS SHALL BE CEDAR OR FIR SPECIES HAVE A 8 FOOT MINIMUM LENGTH, A MINIMUM DIAMETER OF 10 INCHES, AND 3 BRANCHES. ROOT MASS SHALL BE APPROXIMATELY 24-INCHES IN DIAMETER. BARK SHALL BE KEPT INTACT. ENDS THAT HAVE BEEN CUT SHALL BE DISTRESSED AND NOT BLUNT.

B. DEFLECTOR LOGS: LOGS SHALL BE CEDAR OR FIR SPECIES, HAVE A 8 FOOT MINIMUM LENGTH; A MINIMUM DIAMETER OF 10 INCHES, AND 3 BRANCHES. BARK SHALL BE KEPT INTACT. ENDS THAT HAVE BEEN CUT SHALL BE DISTRESSED AND NOT BLUNT.

C. FISH MIX: FISH MIX SHALL CONSIST OF CLEAN, ROUNDED, UNIFORMLY-GRADED GRAVEL WITH FINES LESS THAN 0.25 INCHES NOT EXCEEDING 3.0 PERCENT TOTAL VOLUME. THE SIZE COMPOSITION SHALL BE AS FOLLOWS:

15% 4.0-3.0 INCHES;
40% 3.0-1.5 INCHES;
45% 1.5-0.25 INCHES;

WITH FINES LESS THAN 0.25 INCHES NOT EXCEEDING 3.0 PERCENT TOTAL VOLUME. TALASAEA CONSULTANTS SHALL APPROVE ROCK MIX PLACEMENT.

2.3 TEMPORARY BYPASS AND SANDBAG DAM

A. TEMPORARY BYPASS: THE TEMPORARY BYPASS SHALL BE A FLEXIBLE PIPE COMPOSED OF PVC OR ADSN12. THE PIPE SHALL BE OF SUFFICIENT SIZE TO PASS ALL FLOWS AND DEBRIS, THIS SHALL BE DETERMINED BY THE CONTRACTOR.

2.5 TOPSOIL

A. TOPSOIL: TOPSOIL THAT HAS BEEN STOCKPILED ON-SITE FOR REUSE IN PROJECT AREA(S) OR IMPORTED FROM OFF-SITE SOURCES SHALL BE FERTILE, FRIABLE, SANDY LOAM SURFACE SOIL, FREE OF SUBSOIL, CLAY LUMPS, BRUSH, WEEDS, ROOTS, STUMPS, STONES LARGER THAN 1 INCH IN ANY DIMENSION, LITTER, OR ANY OTHER EXTRANEOUS OR TOXIC MATTER HARMFUL TO PLANT GROWTH.

B. ORGANIC CONTENT: IMPORTED TOPSOIL SHALL CONSIST OF ORGANIC MATERIALS AMENDED AS NECESSARY TO PRODUCE A BULK ORGANIC CONTENT OF AT LEAST 10 PERCENT AND NOT GREATER THAN 20 PERCENT, AS DETERMINED BY AASHTO-T-194.

2.6 MULCH

A. BARK OR WOODCHIP MULCH SHALL BE DERIVED FROM DOUGLAS FIR, PINE, OR HEMLOCK SPECIES. THE MULCH SHALL NOT CONTAIN RESIN, TANNIN, OR OTHER COMPOUNDS IN QUANTITIES THAT WOULD BE DETRIMENTAL TO ANIMAL, PLANT LIFE, OR WATER QUALITY. SAWDUST SHALL NOT BE USED AS MULCH.

B. MULCH SHALL BE MEDIUM-COARSE GROUND WITH AN APPROXIMATELY 3-INCH MINUS PARTICLE SIZE. FINE PARTICLES SHALL BE MINIMIZED SO THAT NOT MORE THAN 30%, BY LOOSE VOLUME, WILL PASS THROUGH A US NO. 4 SIEVE.

PART 3: EXECUTION

3.1 SITE PREPARATION

A. SURVEY/STAKE/FLAG LIMITS OF CLEARING:

1. PRIOR TO ANY CONSTRUCTION, A LICENSED SURVEYOR SHALL SURVEY, STAKE, AND FLAG CLEARING LIMITS. CLEARING LIMITS ARE DEPICTED ON THE MITIGATION PLANS. TALASAEA CONSULTANTS SHALL REVIEW AND APPROVE FLAGGING OF CLEARING LIMITS PRIOR TO ANY VEGETATION REMOVAL. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY ACTUAL LOCATIONS OF VEGETATION TO BE SAVED AND REQUEST THAT TALASAEA CONSULTANTS MODIFY THE GRADING PLAN AS NECESSARY TO AVOID ALL SIGNIFICANT NATIVE VEGETATION.

B. INSTALL TREE PROTECTION FENCING

1. TREES LOCATED OUTSIDE THE CLEARING LIMITS ARE TO BE RETAINED, BUT SOME TREES OUTSIDE THE CLEARING LIMITS MAY BE ADVERSELY AFFECTED BY CONSTRUCTION ACTIVITIES. TALASAEA CONSULTANTS SHALL FLAG RETAINED TREES PRIOR TO CLEARING. CONTRACTOR SHALL INSTALL TREE PROTECTION FENCING 2-FEET BEYOND THE DRIPLINE OF FLAGGED TREES. FLAGGED TREES SHALL NOT BE DISTURBED BEYOND TREE PROTECTION FENCING. FENCING SHALL REMAIN IN PLACE UNTIL THE COMPLETION OF EARTHWORK.

C. FLAG AND PROTECT EXISTING VEGETATION TO REMAIN:

1. CONTRACTOR SHALL BE RESPONSIBLE FOR AVOIDING DISTURBANCE TO EXISTING VEGETATION LOCATED OUTSIDE THE CLEARING LIMITS. NO REMOVAL OF ANY VEGETATION SHALL OCCUR WITHOUT PRIOR APPROVAL BY TALASAEA CONSULTANTS.
2. TALASAEA CONSULTANTS SHALL FLAG EXISTING VEGETATION TO REMAIN LOCATED WITHIN THE PROJECT AREA(S). PRIOR TO GRADING, CONTRACTOR SHALL INSTALL ORANGE BARRIER FENCING 2 FEET BEYOND THE DRIPLINE OF FLAGGED EXISTING VEGETATION. FLAGGED VEGETATION SHALL NOT BE DISTURBED, UNLESS APPROVED IN WRITING BY TALASAEA CONSULTANTS. FENCING SHALL REMAIN IN PLACE UNTIL THE COMPLETION OF EARTHWORK.
3. CONTRACTOR SHALL EXERCISE CARE TO PREVENT INJURY TO THE TRUNK, ROOTS, AND BRANCHES OF TREES AND SHRUBS TO REMAIN. ANY WOODY PLANT TO REMAIN THAT IS DAMAGED DURING CONSTRUCTION SHALL BE TREATED IMMEDIATELY AFTER DAMAGE OCCURS, AND TALASAEA CONSULTANTS SHALL BE NOTIFIED OF INCIDENT. DAMAGE TREATMENT SHALL INCLUDE EVENLY CUTTING BROKEN BRANCHES, BROKEN ROOTS, AND DAMAGED TREE BARK. INJURED PLANTS SHALL BE THOROUGHLY WATERED AND ADDITIONAL MEASURES SHALL BE TAKEN, AS APPROPRIATE, TO AID IN PLANT SURVIVAL.

D. CLEAR AND GRUB SITE:

1. CONTRACTOR SHALL CLEAR AND GRUB AREAS WITHIN THE CLEARING LIMITS SHOWN ON THE MITIGATION PLANS, WITH THE EXCEPTION OF FLAGGED EXISTING VEGETATION TO REMAIN. IN AREAS OF EXISTING VEGETATION, CONTRACTOR SHALL REMOVE BLACKBERRY AND OTHER INVASIVE SPECIES BY HAND, WITH MINIMAL DISTURBANCE TO THE EXISTING VEGETATION. CLEARED AND GRUBBED VEGETATION SHALL BE EXPORTED FROM THE SITE. INVASIVE/EXOTIC PLANT SPECIES TO BE REMOVED AND TREATED IN THE MITIGATION AREA(S) INCLUDE: SCOT'S BROOM, ENGLISH IVY, HIMALAYAN AND EVERGREEN BLACKBERRY, REED CANARYGRASS, PURPLE LOOSESTRIFE, HEDGE BINDWEED (MORNING GLORY), JAPANESE KNOTWEED, THISTLE, AND CREEPING NIGHTSHADE. FOR REED CANARYGRASS, ROOTS SHALL BE REMOVED DOWN TO A MINIMUM DEPTH OF 12 INCHES.
2. TALASAEA CONSULTANTS SHALL DESIGNATE ANY ADDITIONAL PLANT SPECIES TO BE REMOVED PRIOR TO CONSTRUCTION.

E. SALVAGING WOODY MATERIAL FOR FUTURE USE AS HABITAT FEATURES:

1. TALASAEA CONSULTANTS SHALL FLAG EXISTING WOODY MATERIAL (SNAGS, DEFLECTOR LOGS, ROOTWADS, STUMPS, DOWN LOGS, AND BOULDERS), TO BE SALVAGED BY THE CONTRACTOR FROM WITHIN THE DEVELOPMENT FOOTPRINT FOR USE AS HABITAT FEATURES IN THE MITIGATION AREA(S). IT IS INTENDED THAT ALL WOODY MATERIAL NEEDED FOR THE MITIGATION AREAS SHALL BE OBTAINED FROM THE PROJECT SITE. WHENEVER POSSIBLE, HABITAT FEATURES SHALL BE MOVED DIRECTLY TO PERMANENT LOCATIONS. IF NECESSARY, HABITAT FEATURES SHALL BE PLACED IN STOCKPILE AREAS AS NEAR TO PERMANENT LOCATIONS AS POSSIBLE. TALASAEA CONSULTANTS SHALL DESIGNATE STOCKPILE AREAS.
2. CONTRACTOR SHALL EXERCISE CARE WHEN MOVING HABITAT FEATURES TO AVOID BREAKING BRANCHES, SCUFFING BARK, OR BREAKING ROOTS. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO BREAK PIECES INTO USABLE SIZES.
3. IF HABITAT FEATURES ARE NOT AVAILABLE TO BE SALVAGED FROM ANY PORTION OF THE DEVELOPMENT FOOTPRINT, THEN FEATURES SHALL BE PROVIDED BY THE CONTRACTOR FROM AN OFF-SITE LOCATION(S).

F. INSTALL TEMPORARY BYPASS AND SANDBAG DAM:

1. PRIOR TO ANY EARTHWORK ACTIVITY FOR THE NEW STREAM CHANNEL, A TEMPORARY STREAM BYPASS SHALL BE CONSTRUCTED.A TEMPORARY BYPASS SHALL BE CONSTRUCTED AT THE LOCATIONS SHOWN ON THE PLAN. TALASAEA CONSULTANTS SHALL VERIFY BYPASS LOCATION PRIOR TO INSTALLATION.
2. ALL FLOWS ENTERING THE SITE SHALL BE DIVERTED AROUND THE WORK ZONE UNTIL ALL GRADING ACTIVITIES IN THE STREAM CHANNEL ARE COMPLETED.
3. A SANDBAG DAM WILL BE INSTALLED AT THE BYPASS INLET AND AT THE END OF ALL IN-STREAM WORK. THE DAM SHALL BE AT LEAST 36 INCHES HIGH AND SHALL BE SUFFICIENT IN LENGTH/ WIDTH TO PREVENT INCOMING FLOWS FROM SPILLING INTO THE WORK AREA FOR THE DURATION OF THE CONSTRUCTION.
4. ANY TURBID WATER ENCOUNTERED DURING CONSTRUCTION SHALL BE ROUTED VIA A 4-INCH PERFORATED PIPE TO AN UPLAND AREA DESIGNATED BY TALASAEA CONSULTANTS IN WHICH SILT FENCING AND STRAW WATTLES HAVE BEEN INSTALLED TO TRAP SEDIMENTS.
5. ONCE THE STREAM BANK IS STABILIZED AND ALL GRADING IN THE STREAM IS COMPLETE, ALL MATERIAL USED IN THE BYPASS SHALL BE REMOVED FROM THE SITE.

G. PLACE EROSION CONTROL MEASURES:

1. CONTRACTOR SHALL INSTALL EROSION CONTROL MEASURES (SILT FENCING, TEMPORARY SEDIMENTATION PONDS, ROCK AND INTERCEPTOR SWALES, ETC.) ON THE PROJECT SITE AND SILT FENCING DEPICTED ON THE MITIGATION GRADING PLANS PRIOR TO ANY CONSTRUCTION ACTIVITY. CONTRACTOR SHALL MAINTAIN EROSION CONTROL FACILITIES UNTIL COMPLETION OF CONSTRUCTION. TALASAEA CONSULTANTS SHALL VERIFY AND APPROVE LOCATIONS OF EROSION CONTROL MEASURES PRIOR TO SITE GRADING.
2. SITE AREAS EXPOSED DURING GRADING AND CONSTRUCTION MUST BE COVERED WITH STRAW (MAXIMUM DEPTH 3 INCHES), EROSION CONTROL NETTING, PLASTIC SHEETING, OR PERMANENT EROSION CONTROL WITHIN 48 HOURS OF DISTURBANCE, OR AS REQUIRED FOR NPDES OR LOCAL JURISDICTION COMPLIANCE.
3. CONTRACTOR SHALL MAINTAIN EROSION CONTROL MEASURES FOR THE DURATION OF THE PROJECT. THESE MEASURES SHALL REMAIN IN PLACE UNTIL WRITTEN AUTHORIZATION IS GIVEN BY TALASAEA CONSULTANTS FOR REMOVAL OR LOCATION ADJUSTMENT. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO REMOVE ALL EROSION CONTROL MEASURES ADJACENT TO SENSITIVE AREAS WHEN AUTHORIZED BY TALASAEA CONSULTANTS.
4. AS CONSTRUCTION PROGRESSES AND SEASONAL CONDITIONS DICTATE, EROSION CONTROL FACILITIES SHALL BE MAINTAINED AND/OR ALTERED AS REQUIRED BY TALASAEA CONSULTANTS TO ENSURE CONTINUED EROSION/SEDIMENTATION CONTROL.
5. WHERE POSSIBLE, NATURAL GROUND COVER VEGETATION SHALL BE MAINTAINED FOR SILT CONTROL.
6. DURING CONSTRUCTION, THE CONTRACTOR MUST USE MATERIALS AND CONSTRUCTION METHODS THAT PREVENT TOXIC MATERIAL AND OTHER POLLUTANTS FROM ENTERING THE STREAM AND BUFFER AREAS. PREVENTATIVE MEASURES SHALL BE USED TO PROTECT EXISTING STORM DRAINAGE SYSTEMS, EXISTING UTILITIES, AND ROADS.

THIS DEVELOPMENT SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE CITY OF REDMOND STANDARD SPECIFICATIONS AND DETAILS, CURRENT EDITION.

811 Know what's below. Call before you dig.

NOTES

1. SURVEY PROVIDED BY BRH, INC., 2009 MINOR AVENUE EAST SEATTLE, WA 98102, (206) 323-4144.
2. SITE PLAN PROVIDED BY CPL, INC., 801 SECOND AVENUE, SUITE 900, SEATTLE, WA 98104, (206) 343-0460.
3. SOURCE DRAWING WAS MODIFIED BY TALASAEA CONSULTANTS FOR VISUAL ENHANCEMENT.
4. THIS PLAN IS AN ATTACHMENT TO THE CRITICAL AREAS REPORT PREPARED BY TALASAEA CONSULTANTS IN OCTOBER, 2019.

TALASAEA CONSULTANTS, INC.
Resource & Environmental Planning
15020 Bear Creek Road Northeast - Woodinville, Washington 98077
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CRITICAL AREAS DETAILED MITIGATION PLAN
GRADING SPECIFICATIONS
BUILDING X PROJECT
REDMOND, WASHINGTON

Revisions	Date	By
CITY COMMENTS	6-5-2019	FH
CITY COMMENTS	10-10-2019	MK
SITE PLAN ENTITLEMENT	10-18-2019	MK

Date	2-6-2019
Scale	NTS
Designed	AO
Drawn	MK/FH
Checked	AO
Approved	BS

Project # 1732

Sheet # W2.2

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GRADING SPECIFICATIONS (CONTINUED)

3.3 GRADE STAKING AND EXCAVATION

A. SURVEY/STAKE/FLAG PROPOSED GRADES: A LICENSED SURVEYOR SHALL SURVEY, STAKE, AND FLAG PROPOSED GRADES AND STREAM CHANNEL BOTTOM WITHIN THE MITIGATION AREA(S). GRADES SHALL BE STAKED AND FLAGGED AT 25-FOOT INTERVALS AND AT ALL HIGH AND LOW POINTS. TALASAEA CONSULTANTS SHALL APPROVE GRADE STAKING PRIOR TO EXCAVATION AND SHALL MONITOR DURING CONSTRUCTION.

B. STOCKPILE TOPSOIL:

1. CONTRACTOR SHALL SALVAGE AND STOCKPILE TOPSOIL AT APPROPRIATE LOCATIONS ADJACENT TO MITIGATION AREAS.
2. TOPSOIL FROM REMOVED AREAS OF NATIVE VEGETATION ARE THE MOST SUITABLE FOR HABITAT RESTORATION, AND SHOULD BE PRIORITIZED FOR SALVAGE AND RE-USE WITHIN RESTORED AREAS.
3. IF TOPSOIL CONTAINS DEBRIS, OR IS DETERMINED UNSUITABLE BY TALASAEA CONSULTANTS, CONTRACTOR SHALL DISPOSE OF MATERIAL OFF SITE AND IMPORT SUITABLE MATERIAL.

C. EXCAVATE AND GRADE MITIGATION AREAS:

1. CONTRACTOR SHALL EXCAVATE GRADED AREAS PER GRADING PLAN WITHOUT REMOVING GRADE STAKES. TALASAEA CONSULTANTS TO MAKE MINOR FIELD ADJUSTMENTS TO GRADING PLAN, AS NECESSARY, TO ENSURE PROPER FUNCTION OF THE MITIGATION AREA(S).
2. IN THE NEW CHANNEL, CONTRACTOR SHALL OVER-EXCAVATE 6-INCHES BELOW FINISHED ELEVATION SHOWN ON PLANS TO ALLOW FOR LATER PLACEMENT OF 6-INCHES OF ROCK MIX. ROCK MIX IS TO BE PLACED THROUGHOUT THE ENTIRE LENGTH OF THE NEW STREAM CHANNEL (SEE STREAM PROFILES ON MITIGATION PLANS).

   IN REMAINING GRADED BUFFER AREAS, CONTRACTOR SHALL SET SUBGRADE 9-NCHES BELOW FINISHED ELEVATION SHOWN ON PLANS TO ALLOW FOR LATER PLACEMENT OF 9-INCHES TO IMPORTED TOPSOIL. EXCAVATED SOILS SHALL BE USED ON-SITE; IF POSSIBLE, OTHERWISE THEY SHALL BE EXPORTED OFF SITE.
3. FILL SOILS PROPOSED FOR USE WITHIN THE MITIGATION AREA(S) SHALL BE SUBMITTED TO THE GEOTECHNICAL ENGINEER FOR ANALYSIS AND APPROVAL PRIOR TO USE, AND SHALL MEET ALL APPLICABLE SPECIFICATIONS FOR FILL SOILS PER THE PROJECT GEOTECHNICAL ENGINEER. IN AREAS OF FILL PLACEMENT, CONTRACTOR SHALL COMPACT SOIL IN LIFTS ACCORDING TO GEOTECHNICAL ENGINEERING SPECIFICATIONS. GEOTECHNICAL ENGINEER SHALL APPROVE ALL AREAS OF FILL PLACEMENT TO ENSURE ADEQUACY OF COMPACTION. CONTRACTOR SHALL BE NOTIFIED BY THE GENERAL CONTRACTOR AS TO WHO THE GEOTECHNICAL ENGINEER WILL BE.
4. UPON COMPLETION OF EXCAVATION, AND FILLING, TALASAEA CONSULTANTS SHALL REVIEW AND APPROVE SUBGRADE IN RELATION TO ORIGINAL GRADE STAKES. IF GRADE STAKES ARE REMOVED PRIOR TO APPROVAL BY TALASAEA CONSULTANTS, AN AS-BUILT SURVEY MAY BE REQUIRED. THE AS-BUILT SURVEY, BY A LICENSED SURVEYOR, WILL INCLUDE ONE-FOOT CONTOUR INTERVALS WITH SPOT ELEVATIONS OF HIGH AND LOW POINTS, STREAM CENTERLINE, AND THE CREATED WETLAND BOUNDARIES.
5. AFTER SUBGRADE APPROVAL, THE CONTRACTOR SHALL REMOVE GRADE STAKES AND PROCEED WITH IN-STREAM STRUCTURES.

3.4 IN-STREAM STRUCTURES, FISH MIX, & SNAGS

1. FLAG LOCATIONS IN-STREAM STRUCTURES:

   TALASAEA CONSULTANTS SHALL FLAG PLACEMENT LOCATIONS OF IN-STREAM STRUCTURES (ROOTWAD CLUSTERS, DEFLECTOR LOGS, AND BURIED ROOTWADS) AND FISH HABITAT ROCKS PRIOR TO INSTALLATION.

Item	Min size	Diameter	Comments
Deflector logs	8' length	10" dbh. min.	Min. 3 branches exposed
Rootwad clusters	8' length	10" dbh. min.	24" root mass
Rootwads	8' length, 24" dia. min. root MASS	10" dbh. min.	Wash off loose soil

2. INSTALL IN-STREAM STRUCTURES:

   INSTALL IN-STREAM STRUCTURES AT LOCATIONS DEPICTED ON SHEET W2.0 TALASAEA CONSTULANTS SHALL APPROVE IN-STREAM STRUCTURE LOCATIONS PRIOR TO INSTALLATION. ROOTWAD AND DEFLECTOR LOGS SHOULD NOT BLOCK MORE THAN 1/3 FLOW FO CHANNEL.
3. INSTALL ROOTWAD CLUSTERS, DEFLECTOR LOGS & BURIED ROOTWADS:

   PRIOR TO PLACEMENT OF TOPSOIL, ROOTWAD CLUSTERS, DEFLECTOR LOGS & BURIED ROOTWADS SHALL BE INSTALLED AT LOCATIONS DEPICTED ON PLANS. ROOTWAD AND DEFLECTOR LOGS SHOULD NOT BLOCK MORE THAN 1/3 FLOW OF CHANNEL.
4. PLACE FISH MIX IN PRIMARY CHANNEL:

   CONTRACTOR SHALL PLACE ROCK MIX IN CHANNEL PER STREAM PROFILES ON MITIGATION PLANS. TALASAEA CONSULTANTS SHALL APPROVE ROCK MIX PLACEMENT.
5. INSTALL SNAGS:

   INSTALL SNAGS UPON COMPLETION OF SUBGRADE EARTHWORKS AT LOCATIONS DEPICTED ON MITIGATION PLANS. SNAG SHALL BE ANCHORED INTO SUBGRADE A MINIMUM OF 25 PERCENT OF THE TOTAL LENGTH, AS DEPICTED IN THE PLAN DETAIL. TALASAEA CONSULTANTS HALL APPROVE SNAG LOCATIONS PRIOR TO INSTALLATION. ATTACH ONE BIRD NEST BOX TO EACH VERTICAL SNAG (SEE DETAIL).

B. PLACE HABITAT FEATURES

1. HABITAT FEATURES: PLACE HABITAT FEATURES UPON COMPLETION OF TOPSOIL PLACEMENT. AS DEPICTED ON THE MITIGATION PLANS AND DETAILS. TALASAEA CONSULTANTS SHALL APPROVE LOCATIONS PRIOR TO PLACEMENT.
2. DOWN LOGS: TO CUT/BREAK DOWN LOGS, FIRST SCORE THE LOG AT THE DESIRED LENGTH BY MECHANICAL MEANS, THEN SNAP THE LOG AT THE SCORED LOCATION TO CREATE A NATURAL LOOK TO THE BREAK. TWIST BROKEN ENDS TO DISGUISE SAW CUTS. HABITAT FEATURES THAT HAVE BEEN CUT SHALL HAVE NO BLUNT ENDS.
3. STUMPS: STUMPS SHALL BE SET UPRIGHT.
4. BOULDERS: IF AVAILABLE BOULDERS SHALL BE PLACED IN PILES AT LEAST 2 ROCKS DEEP (5 ROCK MIN. PER PILE), IN A MANNER THAT PROVIDES BOTH PHYSICAL STABILITY AND LARGE INTERNAL VOIDS. TALASAEA SHALL ASSIST IN SITING BOULDER LOCATIONS AND PLACEMENT ARRANGEMENTS.

3.5 TOPSOIL AND HABITAT FEATURE (DOWN LOGS AND STUMPS) PLACEMENT AND SEEDING

A. PLACE TOPSOIL:

1. TALASAEA CONSULTANTS SHALL APPROVE SUBGRADE EARTHWORK IN THE STREAM RELOCATION AREA PRIOR TO PLACEMENT OF TOPSOIL.
2. IN ALL GRADED PROJECT AREAS, 9 INCHES OF STOCKPILED OR IMPORTED TOPSOIL SHALL BE PLACED OVER SUBGRADE. TOPSOIL SHALL BE LIGHTLY TRACK-WALKED ON SLOPED AREAS TO PREVENT RILLING AND EROSION.
3. IN NON-GRADED PLANTED PORTIONS OF THE BUFFER AMENDED WITH FERTILIZER.

B. PLACE HABITAT FEATURES

1. HABITAT FEATURES: PLACE HABITAT FEATURES UPON COMPLETION OF TOPSOIL PLACEMENT. AS DEPICTED ON THE MITIGATION PLANS AND DETAILS. TALASAEA CONSULTANTS SHALL APPROVE LOCATIONS PRIOR TO PLACEMENT.
2. DOWN LOGS: TO CUT/BREAK DOWN LOGS, FIRST SCORE THE LOG AT THE DESIRED LENGTH BY MECHANICAL MEANS, THEN SNAP THE LOG AT THE SCORED LOCATION TO CREATE A NATURAL LOOK TO THE BREAK. TWIST BROKEN ENDS TO DISGUISE SAW CUTS. HABITAT FEATURES THAT HAVE BEEN CUT SHALL HAVE NO BLUNT ENDS.
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Item	Min size	Diameter	Comments
Down Logs	20' length, with or without roots	15" dbh. min.	Bark intact
Stumps	3' trunk w/roots		Well decayed
Boulders	1 or 2-man	12" dia. min.	

C. MULCH GRADED BUFFERS AND SEED GRADED AND ISTURBED WETLANDS:

TALASAEA CONSULTANTS SHALL BE PROVIDED A MULCH SAMPLE PRIOR TO IT BEING DELIVERED TO THE SITE. NO BUFFER AREAS SHALL BE SEEDED.

1. CONTRACTOR SHALL SPREAD MULCH OVER ALL GRADED BUFFER AREAS TO ACHIEVE A UNIFORM DEPTH OF 3 INCHES.
2. CONTRACTOR SHALL SEED AND WATER THOROUGHLY ALL GRADED AND DISTURBED WETLAND AREAS WITH THE SEED MIX SPECIFIED IN THE PLANT SCHEDULE.

D. GRADING INSPECTIONS:

1. PRIOR TO PLANTING TALASAEA CONSULTANTS SHALL APPROVE ALL GRADING WORK, AND ALL STRUCTURE AND HABITAT FEATURE PLACEMENT. IF ITEMS ARE TO BE CORRECTED, A PUNCH LIST SHALL BE PREPARED BY TALASAEA CONSULTANTS AND SUBMITTED TO THE CONTRACTOR FOR COMPLETION. AFTER PUNCH LIST ITEMS HAVE BEEN COMPLETED, TALASAEA CONSULTANTS SHALL REVIEW THE PROJECT FOR FINAL INTERNAL ACCEPTANCE OF GRADING PLAN IMPLEMENTATION, AND PLANTING AY THEN PROCEED.

E. SOIL STABILIZATION:

1. IF THERE ARE DELAY IN CONSTRUCTION FOR ANY REASON, CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTENANCE OF EROSION CONTROL MEASURES, DRAINAGE, AND TEMPORARY IRRIGATION DURING CONSTRUCTION DELAY PERIOD, UNLESS OTHERWISE STATED IN WRITING.

3.6 CONSTRUCTION APPROVAL

A. POST GRADING EVALUATION BY TALASAEA

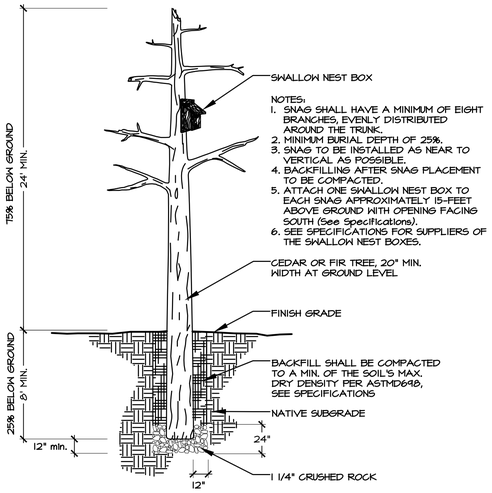
2. UPON COMPLETION OF FINAL GRADING, STRUCTURE INSTALLATION, AND SEEDING, CONTRACTOR SHALL PROVIDE TALASAEA CONSULTANTS WITH A SET OF CLEARLY MARKED PRINTS DESIGNATING THE ACTUAL LOCATIONS OF ELEMENTS WITHIN THE STREAM RELOCATION AND ENHANCED BUFFER AREAS.
3. THE GEOTECHNICAL ENGINEER, PROJECT ENGINEER, AND TALASAEA CONSULTANTS SHALL APPROVE GRADING WORK, STRUCTURE INSTALLATION, AND SEEDING PRIOR TO PLANT INSTALLATION TO CONFIRM THAT THE STREAM RELOCATION PLANS WERE PROPERLY IMPLEMENTED. IF ITEMS ARE TO BE CORRECTED, A PUNCH LIST SHALL BE PREPARED BY TALASAEA CONSULTANTS AND SUBMITTED TO THE CONTRACTOR FOR COMPLETION. AFTER PUNCH LIST ITEMS HAVE BEEN COMPLETED, THE PROJECT SHALL BE REVIEWED FOR FINAL INTERNAL ACCEPTANCE OF GRADING PLAN IMPLEMENTATION AND PLANTING MAY THEN PROCEED.

B. WDFW APPROVAL OF NEW STREAM CORRIDOR

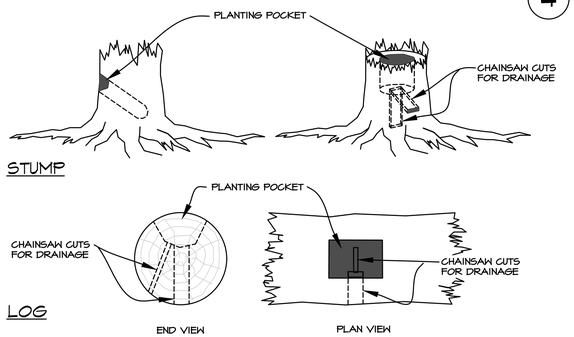
1. THE AREA HABITAT BIOLOGIST SHALL BE CONTACTED WITHIN SEVEN DAYS OF THE COMPLETION OF THE NEW CHANNEL TO ARRANGE FOR COMPLIANCE INSPECTION. UPON REVIEW AND APPROVAL, TALASAEA CONSULTANTS WILL NOTIFY THE CITY INSPECTOR OF SAID APPROVAL FROM WDFW.
2. STREAM DIVERSION SHALL BE CONDUCTED ONLY AFTER INSPECTION AND APPROVAL OF THE NEW CHANNEL BY THE AREA HABITAT BIOLOGIST PER THE HPA REQUIREMENTS.

C. WARRANTY

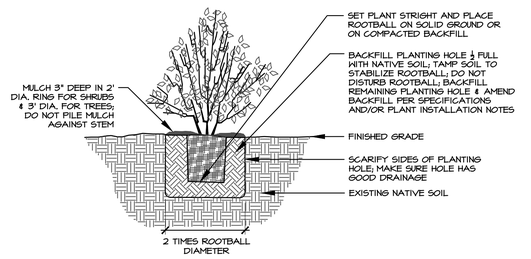
1. CONTRACTOR SHALL ENSURE THAT CONSTRUCTION RELATED ACTIVITIES DO NOT DAMAGE OFF-SITE FEATURES OR ADJACENT VEGETATION. TALASAEA CONSULTANTS SHALL BE NOTIFIED IMMEDIATELY IF ACCIDENTAL DAMAGE OCCURS.
2. CONTRACTOR SHALL ENSURE THAT ADJACENT ROADS ARE MAINTAINED AND CLEAR OF SOIL AND/OR OTHER DEBRIS AT ALL TIMES DURING CONSTRUCTION. CONTRACTOR SHALL COMPLY WITH THE CITY CODES REGARDING STREET MAINTENANCE/CLEANING DURING CONSTRUCTION.
3. ANY CHANGES OR MODIFICATIONS TO THIS PLAN MUST RECEIVE PRIOR APPROVAL FROM TALASAEA CONSULTANTS.



1 SNAG WITH NEST BOX DETAIL
N.T.S.



2 PLANTING POCKETS DETAIL
1"=1'



3 CONTAINER STOCK PLANTING DETAIL
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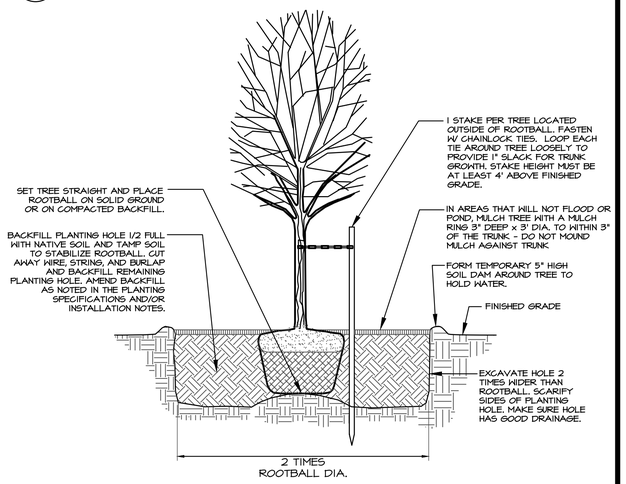

4 B&B TREE PLANTING DETAIL.
NTS

THIS DEVELOPMENT SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE CITY OF REDMOND STANDARD SPECIFICATIONS AND DETAILS, CURRENT EDITION.

811 Know what's **below.** **Call** before you dig.

NOTES

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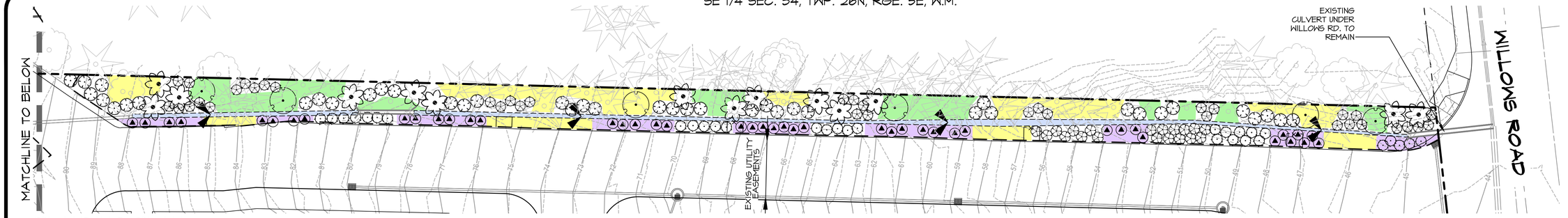
CRITICAL AREAS DETAILED MITIGATION PLAN
GRADING SPECIFICATIONS & DETAILS
BUILDING X PROJECT
REDMOND, WASHINGTON

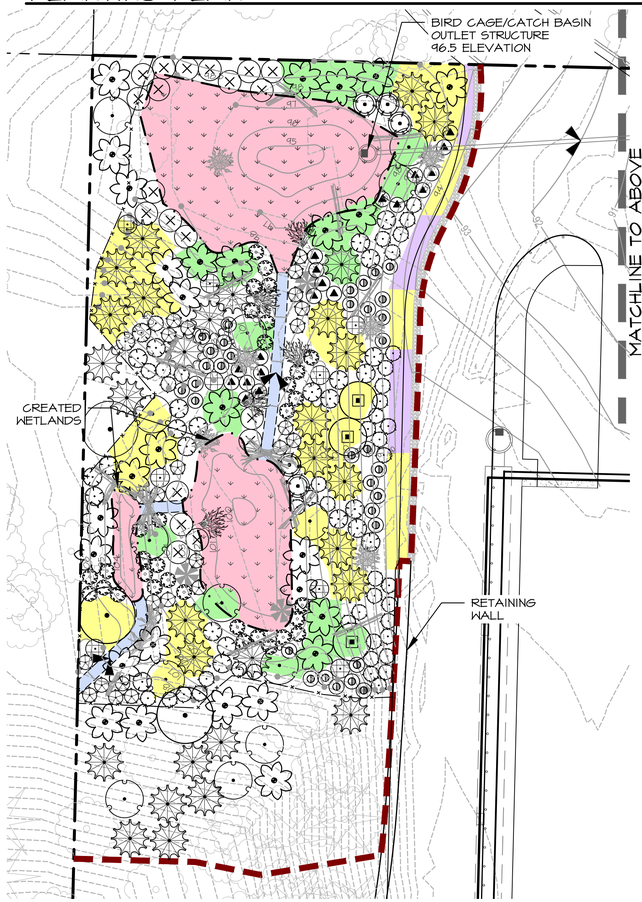
Revisions	Date	By
CITY COMMENTS	6-5-2019	FH
CITY COMMENTS	10-10-2019	MW
SITE PLAN ENTITLEMENT	10-18-2019	MW

Date	2-6-2019
Scale	NTS
Designed	AO
Drawn	MW/FH
Checked	AO
Approved	BS
Project #	1732
Sheet #	W2.3

SE 1/4 SEC. 34, TWP. 26N, RGE. 5E, W.M.



PLANTING PLAN



PLANTING PLAN

GRAPHIC SCALE (IN FEET)
0 10 20 40
SCALE: 1"=20'

NORTH

PLAN LEGEND

- PROPERTY LINE
- EXISTING WETLAND
- STREAM ORDINARY HIGH WATER MARK (OHWM)
- CLEARING LIMITS
- POST CONSTRUCTION BUFFER/CRITICAL AREA FENCE
- EXISTING CONTOUR
- PROPOSED CONTOUR
- EXISTING TREES TO REMAIN (DECIDUOUS - CONIFER)

PLANT SCHEDULE

LARGE TREES

KEY	SCIENTIFIC NAME	COMMON NAME	QTY.	WL STATUS	SPACING	SIZE (MIN)	NOTES	NATIVE	ADAPTIVE	DROUGHT TOLERANT
	ACER MACROPHYLLUM	BIG LEAF MAPLE	3	FACU	AS SHOWN	2.5" CAL.	SINGLE TRUNK, WELL BRANCHED	X	-	X
	PSEUDOTSUGA MENZIESII	DOUGLAS FIR	30	FACU	AS SHOWN	6' HT.	FULL & BUSHY	X	-	X
	THUJA PLICATA	WESTERN RED CEDAR	43	FAC	AS SHOWN	6' HT.	FULL & BUSHY	X	-	X

SMALL TREES

KEY	SCIENTIFIC NAME	COMMON NAME	QTY.	WL STATUS	SPACING	SIZE (MIN)	NOTES	NATIVE	ADAPTIVE	DROUGHT TOLERANT
	ACER CIRCINATUM	VINE MAPLE	19	FAC	AS SHOWN	4' HT.	MULTI-STEM (3 MIN.)	X	-	X
	PRUNUS EMARGINATA	BITTERCHERRY	3	FACU	AS SHOWN	4-5' HT.	SINGLE TRUNK, WELL BRANCHED	X	-	X

LARGE SHRUBS

KEY	SCIENTIFIC NAME	COMMON NAME	QTY.	WL STATUS	SPACING	SIZE (MIN)	NOTES	NATIVE	ADAPTIVE	DROUGHT TOLERANT
	OEMLERIA CERASIFORMIS	INDIAN PLUM	69	FACU	5' O.C.	24" HT.	MULTI-CANE (3 MIN.)	X	-	X
	SALIX LASIANDRA	PACIFIC WILLOW	5	FACW	AS SHOWN	4' CUTTING (3/SYMBOL)	MULTI-CANE (3 MIN.)	X	-	X
	SALIX SITCHENSIS	SITKA WILLOW	20	FAC	AS SHOWN	4' CUTTING (3/SYMBOL)	MULTI-CANE (3 MIN.)	X	-	X
	SAMBUCUS RACEMOSA	RED ELDERBERRY	9	FACU	5' O.C.	24" HT.	MULTI-CANE (3 MIN.)	X	-	X

MASSING SHRUBS

KEY	SCIENTIFIC NAME	COMMON NAME	QTY.	WL STATUS	SPACING	SIZE (MIN)	NOTES	NATIVE	ADAPTIVE	DROUGHT TOLERANT
	CORNUS ALBA	RED-OSIER DOGWOOD	63	FACW	4' O.C.	18" HT.	MULTI-CANE (3 MIN.)	X	-	X
	ROSA NUTKANA	NOOTKA ROSE	19	FAC	4' O.C.	18" HT.	MULTI-CANE (3 MIN.)	X	-	X
	LONICERA INVOLUCRATA	BLACK TWIN-BERRY	63	FAC	4' O.C.	18" HT.	MULTI-CANE (3 MIN.)	X	-	X
	RUBUS SPECTABILIS	SALMONBERRY	33	FAC	4' O.C.	18" HT.	MULTI-CANE (3 MIN.)	X	-	X
	RUBUS PARVIFLORUS	THIMBLEBERRY	33	FACU	4' O.C.	18" HT.	MULTI-CANE (3 MIN.)	X	-	X
	SYMPHORICARPOS ALBUS	COMMON SNOWBERRY	75	FACU	4' O.C.	18" HT.	MULTI-CANE (3 MIN.)	X	-	X

GROUNDCOVER

KEY	SCIENTIFIC NAME	COMMON NAME	QTY.	WL STATUS	SPACING	SIZE (MIN)	NOTES	NATIVE	ADAPTIVE	DROUGHT TOLERANT
	FESTUCA IDAHONENSIS	FESCUE IDAHO	815	FACU	2' O.C.	1 GAL.	FULL & BUSHY	X	-	X
	FRAGARIA VESCA	WOODLAND STRAWBERRY	815	FACU	12" O.C.	1 GAL.	FULL & BUSHY	X	-	X
	GAULTHERIA SHALLON	SALAL	563	FACU	3' O.C.	1 GAL.	FULL & BUSHY	X	-	X
	POLYSTICHUM MUNITUM	SWORD FERN	336	FACU	3' O.C.	1 GAL.	FULL & BUSHY	X	-	X

EMERGENTS

KEY	SCIENTIFIC NAME	COMMON NAME	QTY.	WL STATUS	SPACING	SIZE (MIN)	NOTES	NATIVE	ADAPTIVE	DROUGHT TOLERANT
	CAREX OBNUPTA	SLOUGH SEDGE	875	OBL	18" O.C.	PLUGS	50%	X	-	X
	SCIRPUS MICROCARPUS	SMALL-FRUITED BULRUSH	875	OBL	18" O.C.	PLUGS	50%	X	-	X

GENERAL PLANT INSTALLATION NOTES

1. PLANT TREES AND/OR SHRUBS 1" HIGHER THAN DEPTH GROWN AT NURSERY.
2. FOR CONTAINER TREES AND/OR SHRUBS, SCORE FOUR SIDES OF ROOTBALL PRIOR TO PLANTING. BUTTERFLY ROOTBALL IF ROOT CIRCLING IS EVIDENT.
3. STAKE DECIDUOUS AND EVERGREEN TREES 4 FEET AND OVER IN HEIGHT WITH ONE (1) STAKE PER TREE. STAKE TREES IMMEDIATELY AFTER PLANTING. PLACE STAKE AT THE OUTER EDGE OF THE ROOTS OR ROOTBALL, IN LINE WITH THE PREVAILING WIND. STAKES SHALL BE LOOSELY ATTACHED USING CHAIN-LOCK TREE TIES TO ALLOW FOR SOME TRUNK MOVEMENT. STAKES TO BE VERTICAL, PARALLEL, EVEN-TOPPED, UNSCARRED AND DRIVEN INTO UNDISTURBED SUBGRADE. REMOVE AFTER ONE YEAR.
4. WATER PLANTS IMMEDIATELY UPON PLANTING, THEN PROVIDE MANUAL WATERING OR A TEMPORARY IRRIGATION SYSTEM TO PREVENT PLANT MORTALITY AND ENSURE PROPER PLANT ESTABLISHMENT. PLANTS SHALL RECEIVE A MINIMUM OF APPROXIMATELY ONE INCH OF WATER EVERY WEEK DURING THE DRY SEASON (GENERALLY JUNE 15TH - OCTOBER 15TH, OR EARLIER OR LATER IF CONDITIONS WARRANT) FOR THE FIRST SEASON AFTER PLANTING. IRRIGATION AMOUNTS MAY NEED TO BE INCREASED DURING PROLONGED PERIODS OF HOT, DRY WEATHER.
5. FERTILIZE ALL TREES AND SHRUBS WITH A SLOW-RELEASE GENERAL PURPOSE GRANULAR FERTILIZER OR SLOW-RELEASE TABLETS AT MANUFACTURER'S SPECIFIED RATE.
6. ALL PLANTING AREAS SHALL HAVE A MINIMUM 9-INCH DEPTH OF TOPSOIL. IF TOPSOIL IS INSUFFICIENT IN EITHER QUANTITY OR QUALITY WITHIN PLANTING AREAS, AS DETERMINED BY TALASAEA CONSULTANTS, TOPSOIL SHALL BE RESTORED BY EITHER RE-INSTALLING PREVIOUSLY STOCKPILED TOPSOIL, IMPORTING NEW TOPSOIL, OR AMENDING EXISTING SOILS IN PLACE WITH ORGANIC MATTER TO ACHIEVE A 9" MINIMUM DEPTH. ALL TOPSOIL SHALL HAVE A BULK ORGANIC CONTENT OF AT LEAST 10 PERCENT AND NOT GREATER THAN 20 PERCENT, AS DETERMINED BY AASHTO-T-194. TOPSOIL THAT HAS BEEN STOCKPILED ON-SITE FOR REUSE IN PROJECT AREA(S) OR IMPORTED FROM OFF-SITE SOURCES SHALL BE FERTILE, FRIABLE, SANDY LOAM SURFACE SOIL, FREE OF SUBSOIL, CLAY LUMPS, BRUSH, WEEDS, ROOTS, STUMPS, STONES LARGER THAN 1 INCH IN ANY DIMENSION, LITTER, OR ANY OTHER EXTRANEOUS OR TOXIC MATTER HARMFUL TO PLANT GROWTH.
7. PROVIDE 3-INCH MINIMUM DEPTH OF MEDIUM BARK MULCH IN ALL PLANTING AREAS. NOTE: 3 INCHES IS THE MINIMUM DEPTH AFTER SETTLING. IF MULCH IS INSTALLED BY BLOWER TRUCK IT SHALL BE INSTALLED AT A 4-INCH DEPTH TO ENSURE A MINIMUM 3-INCH DEPTH AFTER SETTLING. MULCH SHALL BE DERIVED FROM FIR, PINE, OR HEMLOCK SPECIES AND SHALL NOT CONTAIN TRASH, ROCKS, OR OTHER DEBRIS OR MATERIALS DETRIMENTAL TO PLANT GROWTH. MULCH SHALL BE MEDIUM-COURSE GROUND WITH AN APPROXIMATELY 3-INCH MINUS PARTICLE SIZE. FINE PARTICLES SHALL BE MINIMIZED SO THAT NOT MORE THAN 30 PERCENT, BY LOOSE VOLUME, WILL PASS THROUGH A U.S. NO. 4 SIEVE.

THIS DEVELOPMENT SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE CITY OF REDMOND STANDARD SPECIFICATIONS AND DETAILS, CURRENT EDITION.

811 Know what's below. Call before you dig.

NOTES

1. SURVEY PROVIDED BY BRH, INC., 2009 MINOR AVENUE EAST SEATTLE, WA 98102, (206) 323-4144.
2. SITE PLAN PROVIDED BY CPL, INC., 801 SECOND AVENUE, SUITE 900, SEATTLE, WA 98104, (206) 343-0460.
3. SOURCE DRAWING WAS MODIFIED BY TALASAEA CONSULTANTS FOR VISUAL ENHANCEMENT.
4. THIS PLAN IS AN ATTACHMENT TO THE CRITICAL AREAS REPORT PREPARED BY TALASAEA CONSULTANTS IN OCTOBER, 2019.

TALASAEA CONSULTANTS, INC.
Resource & Environmental Planning
15020 Bear Creek Road Northeast - Woodinville, Washington 98077
Phn (425) 861-7550 - Fax (425) 861-7549

CRITICAL AREAS DETAILED MITIGATION PLAN
PLANTING PLAN, PLANT SCHEDULE, NOTES & DETAILS
BUILDING X PROJECT
REDMOND, WASHINGTON

Revisions	Date	By
CITY COMMENTS	6-5-2019	FH
CITY COMMENTS	10-10-2019	MM
SITE PLAN ENTITLEMENT	10-18-2019	MM

Date	2-6-2019
Scale	AS NOTED
Designed	AO
Drawn	MM/FH
Checked	AO
Approved	BS

Project # 1732

Sheet # W3.0

PLANTING SPECIFICATIONS

PART 1: GENERAL

1.1 SEQUENCING

A. GENERAL CONSTRUCTION

1. CONTRACTOR SHALL GIVE THE PROJECT BIOLOGIST OR ECOLOGIST A MINIMUM OF TEN (10) DAYS NOTICE PRIOR TO COMMENCING CONSTRUCTION.
2. NO CONSTRUCTION WORK SHALL COMMENCE UNTIL THERE IS A MEETING BETWEEN THE CLIENT, THE PROJECT BIOLOGIST OR ECOLOGIST, THE GENERAL, CLEARING, AND/OR EARTHWORK CONTRACTORS, AND THE LANDSCAPE CONTRACTOR. THE APPROVED PLANS AND SPECIFICATIONS SHALL BE REVIEWED TO ENSURE THAT ALL PARTIES INVOLVED UNDERSTAND THE INTENT AND THE SPECIFIC DETAILS RELATED TO THE CONSTRUCTION DOCUMENTS, SPECIFICATIONS, AND SITE CONSTRAINTS.
3. LOCATIONS OF EXISTING UTILITIES HAVE BEEN ESTABLISHED BY FIELD SURVEY OR OBTAINED FROM AVAILABLE RECORDS AND SHOULD BE CONSIDERED APPROXIMATE ONLY AND NOT NECESSARILY COMPLETE. IT IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR TO: (1) INDEPENDENTLY VERIFY THE ACCURACY OF UTILITY LOCATIONS, AND (2) DISCOVER AND AVOID ANY UTILITIES WITHIN THE MITIGATION AREA(S) THAT ARE NOT SHOWN, BUT WHICH MAY BE AFFECTED BY IMPLEMENTATION OF THE PLAN. SUCH AREA(S) ARE TO BE CLEARLY MARKED IN THE FIELD. THE PROJECT BIOLOGIST OR ECOLOGIST SHALL RESOLVE ANY CONFLICTS WITH THE APPROVED GRADING PLAN PRIOR TO START OF CONSTRUCTION.
4. A COPY OF THE APPROVED PLANS MUST BE ON SITE WHENEVER CONSTRUCTION IS IN PROGRESS, AND SHALL REMAIN ON SITE UNTIL PROJECT COMPLETION.
5. CONSTRUCTION MUST BE PERFORMED IN ACCORDANCE WITH ALL AGENCY STANDARDS, RULES, CODES, PERMIT CONDITIONS, AND/OR OTHER APPLICABLE ORDINANCES AND POLICIES.
6. THE PROJECT OWNER/APPLICANT IS RESPONSIBLE FOR OBTAINING ANY OTHER RELATED OR REQUIRED PERMITS PRIOR TO THE START OF CONSTRUCTION.
7. A QUALIFIED WETLAND CONSULTANT SHALL BE ON SITE, AS NECESSARY, TO MONITOR CONSTRUCTION AND APPROVE MINOR REVISIONS TO THE PLAN.
8. DURING CONSTRUCTION, THE CONTRACTOR MUST USE MATERIALS AND CONSTRUCTION METHODS THAT PREVENT TOXIC SUBSTANCES AND OTHER POLLUTANTS FROM ENTERING MITIGATION AREAS OR OTHER NATURAL WATERS OF THE STATE.
9. PREVENTATIVE MEASURES SHALL BE USED TO PROTECT EXISTING STORM DRAINAGE SYSTEMS, EXISTING UTILITIES, AND ROADS.
10. PROVIDE SEDIMENT AND EROSION CONTROLS AROUND THE PROJECT AREA PRIOR TO SOIL DISTURBANCE FROM CONSTRUCTION ACTIVITY.

B. MITIGATION CONSTRUCTION: THE FOLLOWING PROVIDES THE GENERAL SEQUENCE OF ACTIVITIES ANTICIPATED TO BE NECESSARY TO COMPLETE THE PLANTING PORTION OF THE MITIGATION PROJECT. SOME OF THESE ACTIVITIES MAY BE CONDUCTED CONCURRENTLY AS THE PROJECT PROGRESSES.

1. CONDUCT A SITE MEETING BETWEEN THE CONTRACTOR, THE PROJECT BIOLOGIST OR ECOLOGIST, AND THE OWNER'S REPRESENTATIVE TO REVIEW THE PROJECT PLANS, STAGING/STOCKPILE AREAS, AND MATERIAL DISPOSAL AREAS.
2. PLANT TREES AND SHRUBS AS INDICATED ON MITIGATION PLANS.
3. PLANT WETLAND EMERGENTS AND STAKES (CUTTINGS).
4. MULCH PLANTS INSTALLED IN NON-GRADED BUFFER AREAS.
5. INSTALL TEMPORARY IRRIGATION SYSTEM AND PROGRAM FOR 0.5 INCHES OF WATER EVERY 3 DAYS.
6. INSTALL FENCING AND CRITICAL AREA PROTECTION SIGNS.

1.2 SUBMITTALS

A. PRODUCT DATA: FURNISH THE FOLLOWING WITH EACH PLANT MATERIAL DELIVERY:

1. INVOICES INDICATING SIZES AND VARIETY OF PLANT MATERIAL.
2. CERTIFICATES OF INSPECTION REQUIRED BY STATE AND FEDERAL AGENCIES.

B. QUALITY CONTROL SUBMITTALS:

1. PRIOR TO DELIVERY OF MATERIALS, CERTIFICATES OF COMPLIANCE ATTESTING THAT MATERIALS MEET THE SPECIFIED REQUIREMENTS SHALL BE FURNISHED FOR THE FOLLOWING: PLANTS, TOPSOIL, FERTILIZER, AND ORGANIC MULCH. CERTIFIED COPIES OF THE MATERIAL CERTIFICATES SHALL INCLUDE THE FOLLOWING:
   a. PLANT MATERIALS: BOTANICAL NAME, COMMON NAME, SIZE, QUANTITY BY SPECIES, AND LOCATION WHERE GROWN.
   b. IMPORTED TOPSOIL: PARTICLE SIZE, PH, ORGANIC MATTER CONTENT, TEXTURAL CLASS, SOLUBLE SALTS, CHEMICAL AND MECHANICAL ANALYSES.
   c. FERTILIZER: CHEMICAL ANALYSIS AND PERCENT COMPOSITION.
   d. IMPORTED MULCH: COMPOSITION AND SOURCE.

1.3 REFERENCES

A. SIZE AND GRADING STANDARDS: SHALL CONFORM TO THE CURRENT EDITION OF THE AMERICAN STANDARD FOR NURSERY STOCK, PUBLISHED BY THE AMERICAN NURSERY AND LANDSCAPE ASSOCIATION.

1.4 QUALITY ASSURANCE

A. WORKER'S QUALIFICATIONS: THE PERSONS PERFORMING THE PLANTING AND THEIR SUPERVISOR(S) SHALL BE PERSONALLY EXPERIENCED WITH PLANTING AND CARING FOR PLANT MATERIAL, AND SHALL HAVE BEEN REGULARLY EMPLOYED BY A COMPANY ENGAGED IN PLANTING AND CARING FOR PLANT MATERIAL FOR A MINIMUM OF 2 YEARS.

B. PLANT MATERIAL: ALL PLANT MATERIALS SHALL BE LOCALLY GROWN OR REGIONALLY ACCLIMATIZED TO THE PACIFIC NORTHWEST.

1.5 DELIVERY, INSPECTION, STORAGE AND HANDLING

A. DELIVERY: A DELIVERY SCHEDULE SHALL BE PROVIDED AT LEAST 10 CALENDAR DAYS PRIOR TO THE FIRST DAY OF DELIVERY. PLANT MATERIALS SHALL BE DELIVERED TO THE JOB SITE NOT MORE THAN 7 WORKING DAYS PRIOR TO THEIR RESPECTIVE PLANTING DATES.

B. PROTECTION DURING DELIVERY: PLANT MATERIAL SHALL BE PROTECTED DURING DELIVERY TO PREVENT DESICCATION AND DAMAGE TO THE BRANCHES, TRUNK, ROOT SYSTEM, OR EARTH BALL. BRANCHES SHALL BE PROTECTED BY TYING-IN. EXPOSED BRANCHES SHALL BE COVERED DURING TRANSPORT.

C. FERTILIZER: FERTILIZER SHALL BE DELIVERED IN MANUFACTURER'S STANDARD SIZED BAGS SHOWING WEIGHT, ANALYSIS, AND MANUFACTURER'S NAME. STORE UNDER A WATERPROOF COVER OR IN A DRY PLACE AS DESIGNATED BY THE OWNER'S REPRESENTATIVE.

D. INSPECTION: ALL PLANT MATERIALS SHALL BE INSPECTED UPON ARRIVAL AT THE JOB SITE BY THE OWNER'S REPRESENTATIVE FOR CONFORMITY TO TYPE AND QUANTITY WITH REGARD TO THEIR RESPECTIVE SPECIFICATIONS.

E. MULCH: A MULCH SAMPLE SHALL BE INSPECTED BY THE PROJECT BIOLOGIST OR ECOLOGIST PRIOR TO THE MULCH BEING DELIVERED TO THE SITE.

F. STORAGE:

1. PLANT MATERIAL NOT INSTALLED ON THE DAY OF ARRIVAL AT THE SITE SHALL BE STORED AND PROTECTED IN DESIGNATED AREAS. PLANTS STORED ON THE PROJECT SITE SHALL BE PROTECTED FROM EXTREME WEATHER CONDITIONS BY INSULATING THE ROOTS, ROOT BALLS OR CONTAINERS WITH SAWDUST, SOIL, COMPOST, BARK OR WOODCHIPS. PLANT MATERIAL SHALL BE PROTECTED FROM DIRECT EXPOSURE TO WIND AND SUN. BARE-ROOT PLANT MATERIAL SHALL BE HEELED-IN. CUTTINGS AND EMERGENT PLANTS MUST BE PROTECTED FROM DRYING AT ALL TIMES AND SHALL BE HEELED-IN WITH MOIST SOIL OR OTHER INSULATING MATERIAL. ALL PLANT MATERIAL STORED ON-SITE SHALL BE WATERED DAILY UNTIL INSTALLED.
2. STORAGE OF OTHER MATERIALS SHALL BE IN DESIGNATED AREAS.

1.6 SCHEDULING

A. PLANTING SEASON: INSTALL WOODY PLANTS BETWEEN OCTOBER 1 AND FEBRUARY 15 WHENEVER THE TEMPERATURE IS ABOVE 32 DEGREES F AND THE SOIL IS IN A WORKABLE CONDITION, UNLESS OTHERWISE APPROVED IN WRITING. CUTTINGS SHALL ONLY BE USED IF PLANTING OCCURS BETWEEN DECEMBER 1ST AND APRIL 1ST.

B. PLANT INSTALLATION: EXCEPT FOR CONTAINER-GROWN PLANT MATERIAL, THE MAXIMUM TIME BETWEEN THE DIGGING AND INSTALLATION OF PLANT MATERIAL SHALL BE 21 DAYS. THE MAXIMUM TIME BETWEEN PLANT INSTALLATION AND MULCH PLACEMENT SHALL BE 72 HOURS.

1.7 WARRANTY

A. WARRANTY PERIOD: THE CONTRACTOR-PROVIDED WARRANTY SHALL EXTEND FOR A PERIOD OF ONE YEAR FROM THE DATE OF PHYSICAL COMPLETION. PHYSICAL COMPLETION FOR THE WORK OF THIS SECTION IS THE DATE WHEN ALL GRADING, PLANTING, IRRIGATION, AND RELATED WORK HAS BEEN COMPLETED AND IS ACCEPTED BY THE OWNER'S REPRESENTATIVE, THE PROJECT BIOLOGIST OR ECOLOGIST, AND APPLICABLE AGENCIES.

B. WARRANTY TERMS: CONTRACTOR'S WARRANTY SHALL INCLUDE REPLACEMENT OF PLANTS DUE TO MORTALITY (SAME SIZE AND SPECIES SHOWN ON THE DRAWINGS). PLANTS REPLACED UNDER THIS WARRANTY SHALL BE WARRANTED FOR AN ADDITIONAL YEAR AFTER REPLACEMENT.

C. EXCEPTIONS: LOSS DUE TO EXCESSIVELY SEVERE CLIMATOLOGICAL CONDITIONS (SUBSTANTIATED BY 10-YEAR RECORDED WEATHER CHARTS), OR CASES OF NEGLECT BY OWNER, OR CASES OF ABUSE/DAMAGE BY OTHERS.

PART 2: PRODUCTS AND MATERIALS

2.1 PLANTS

A. GENERAL: ALL PLANT MATERIAL WILL CONFORM TO THE VARIETIES SPECIFIED OR SHOWN IN THE PLANT LIST(S) INDICATED ON THE MITIGATION PLANS AND BE TRUE TO BOTANICAL NAME AS LISTED IN: HITCHCOCK, C.L., AND A. CRONQUIST. 1973. FLORA OF THE PACIFIC NORTHWEST. UNIVERSITY OF WASHINGTON PRESS.

B. SHRUBS AND TREES:

1. THE PROJECT BIOLOGIST OR ECOLOGIST SHALL EXAMINE PLANT MATERIAL PRIOR TO PLANTING. ANY MATERIAL NOT MEETING THE REQUIRED SPECIFICATIONS SHALL BE IMMEDIATELY REMOVED FROM THE SITE AND REPLACED WITH LIKE MATERIAL THAT MEETS THE REQUIRED STANDARDS. PLANT MATERIAL SHALL MEET THE REQUIREMENTS OF STATE AND FEDERAL LAWS WITH RESPECT TO PLANT DISEASE AND INFESTATIONS. INSPECTION CERTIFICATES, REQUIRED BY LAW, SHALL ACCOMPANY EACH AND EVERY SHIPMENT AND SHALL BE SUBMITTED TO THE PROJECT BIOLOGIST OR ECOLOGIST UPON CONTRACTOR'S RECEIPT OF PLANT MATERIAL.
2. PLANT MATERIALS SHALL BE LOCALLY GROWN (WESTERN WASHINGTON, WESTERN OREGON, OR WESTERN BC), HEALTHY, BUSHY, IN VIGOROUS GROWING CONDITION, AND GUARANTEED TO BE TRUE TO SIZE, NAME, AND VARIETY. IF REPLACEMENT OF PLANT MATERIAL IS NECESSARY DUE TO CONSTRUCTION DAMAGE OR PLANT FAILURE WITHIN ONE YEAR OF INSTALLATION, THE SIZES, SPECIES, AND QUANTITIES SHALL BE EQUAL TO SPECIFIED PLANTS, AS INDICATED ON THE PLANS.
3. PLANTS SHALL BE NURSERY GROWN, WELL-ROOTED, OF NORMAL GROWTH AND CHARACTER, AND FREE FROM DISEASE OR INFESTATION. THE PROJECT BIOLOGIST OR ECOLOGIST RESERVES THE RIGHT TO REQUIRE REPLACEMENT OR SUBSTITUTION OF ANY PLANTS DEEMED UNSUITABLE.
4. TREES SHALL HAVE UNIFORM BRANCHING, SINGLE STRAIGHT TRUNKS (UNLESS SPECIFIED AS MULTI-STEM, MULTI-CANE, OR MULTI-TRUNK), AND AN INTACT AND UNDAMAGED CENTRAL LEADER. CONTAINER STOCK SHALL HAVE BEEN GROWN IN A CONTAINER FOR AT LEAST ONE FULL GROWING SEASON AND SHALL HAVE A WELL DEVELOPED ROOT SYSTEM. PLANT MATERIAL THAT IS ROOT-BOUND OR HAS DAMAGED ROOT ZONES OR BROKEN ROOT BALLS WILL NOT BE ACCEPTED.
5. CONIFEROUS TREES SHALL BE NURSERY GROWN, FULL AND BUSHY, WITH UNIFORM BRANCHING AND A NATURAL, NON-SHEARED FORM. ORIGINAL CENTRAL LEADER MUST BE HEALTHY AND UNDAMAGED. MAXIMUM GAP BETWEEN BRANCHING SHALL NOT EXCEED 9 INCHES, AND LENGTH OF TOP LEADER SHALL NOT EXCEED 12 INCHES.
6. SHRUBS SHALL HAVE A MINIMUM OF THREE STEMS AND SHALL BE A MINIMUM HEIGHT OF 18 INCHES.
7. TREES AND SHRUBS SHALL HAVE DEVELOPED ROOT AND BRANCH SYSTEMS. DO NOT PRUNE BRANCHES BEFORE DELIVERY.
8. NATIVE PLANT CUTTINGS SHALL BE GROWN AND COLLECTED IN THE MARITIME PACIFIC NORTHWEST. CUTTINGS SHALL BE OF ONE TO TWO-YEAR-OLD WOOD, ½ INCH DIAMETER MINIMUM. CUTTINGS SHALL BE A MINIMUM OF 4 FEET IN LENGTH WITH 4 LATERAL BUDS EXPOSED ABOVE GROUND AFTER PLANTING. THE TOP OF EACH CUTTING SHALL BE A MINIMUM OF 1 INCH ABOVE A LEAF BUD, THE BOTTOM CUT 2 INCHES BELOW A BUD. THE BASAL ENDS OF THE CUTTINGS SHALL BE CUT AT A 45 DEGREE ANGLE AND MARKED CLEARLY SO THAT THE ROOTING END IS PLANTED IN THE SOIL. CUTTINGS MUST BE KEPT COVERED AND MOIST DURING STORAGE AND TRANSPORT, AND NO CUTTINGS SHALL BE STORED MORE THAN THREE DAYS FROM DATE OF CUTTING. CUTTINGS SHALL ONLY BE USED IF PLANTING OCCURS BETWEEN DECEMBER 1ST AND APRIL 1ST. FOR PLANTING BETWEEN APRIL 1ST AND DECEMBER 1ST, CONTAINER PLANTS SHALL BE USED.
9. PLANTS SHALL BE FREE OF SPLITS AND CHECKS, BARK ABRASIONS, AND DISFIGURING KNOTS.
10. FOR DECIDUOUS PLANTS, BUDS SHALL BE INTACT AND REASONABLY CLOSED AT TIME OF PLANTING, IF DORMANT.
11. BALLED AND BURLAPPED PLANTS SHALL HOLD A NATURAL BALL. MANUFACTURED ROOT BALLS ARE UNACCEPTABLE.
12. PLANTS SHALL CONFORM TO SIZES INDICATED ON THE PLANT SCHEDULE. PLANTS MAY BE LARGER THAN THE MINIMUM SIZES SPECIFIED.

C. WETLAND EMERGENT PLANTS:

1. SPECIES OF EMERGENT PLANTS SHALL BE PROVIDED AS DESCRIBED ON THE MITIGATION PLANS.
2. HERBACEOUS PLANTS SPECIFIED AS CLUMP DIVISIONS SHALL BE WELL-ROOTED PORTIONS OF MATURE PLANTS WITH A MINIMUM HEIGHT OF 6 INCHES OF VIGOROUS, VEGETATIVE GROWTH ABOVE THE GROUND SURFACE. OTHER HERBACEOUS PLANTS, OTHER THAN CLUMP DIVISIONS, SHALL BE DORMANT PROPAGULES SUCH AS RHIZOMES, TUBERS, CORMS, AND BULBS. PROPAGULE SHOOTS SHALL EXHIBIT TURGOR AND BE LIGHT IN COLOR, AND PROPAGULE BODIES SHALL BE RIGID TO THE TOUCH. IF THE BODIES OF THE PROPAGULES ARE SOFT AND MUSHY AND THE SHOOTS LACK TURGOR AND ARE DARK IN COLOR, THE PLANT MATERIALS SHALL BE REJECTED.
3. RHIZOMES, TUBERS, CORMS, AND BULBS SHALL HAVE A MINIMUM DIAMETER OF 1½ INCHES.

D. NOXIOUS SPECIES: ALL PLANT STOCK AND OTHER RE-VEGETATION MATERIALS SHALL BE FREE FROM THE SEED OR OTHER PLANT COMPONENTS OF ANY NOXIOUS OR INVASIVE SPECIES, AS IDENTIFIED BY THE KING COUNTY NOXIOUS WEED CONTROL BOARD.

E. SUBSTITUTIONS: SUBSTITUTIONS WILL NOT BE PERMITTED WITHOUT A WRITTEN REQUEST AND APPROVAL FROM THE OWNER'S REPRESENTATIVE, THE PROJECT BIOLOGIST OR ECOLOGIST, AND APPLICABLE AGENCIES.

2.2 PLANTING SOIL

A. TOPSOIL: IF SUITABLE STOCKPILED NATIVE TOPSOIL IS NOT AVAILABLE FOR MITIGATION PLANTINGS, TOPSOIL SHALL BE OBTAINED FROM OUTSIDE SOURCES. STOCKPILED OR IMPORTED TOPSOIL SHALL BE FERTILE, FRIABLE, SANDY LOAM SURFACE SOIL, FREE OF SUBSOIL, CLAY LUMPS, BRUSH, WEEDS, ROOTS, STUMPS, STONES LARGER THAN 1 INCH IN ANY DIMENSION, LITTER, OR ANY OTHER EXTRANEOUS OR TOXIC MATTER HARMFUL TO PLANT GROWTH.

B. ORGANIC CONTENT: IMPORTED TOPSOIL SHALL CONSIST OF ORGANIC MATERIALS AMENDED AS NECESSARY TO PRODUCE A BULK ORGANIC CONTENT OF AT LEAST 10 PERCENT AND NOT GREATER THAN 20 PERCENT, AS DETERMINED BY AASHTO-T-194.

C. COMPOST: COMPOST SHALL MEET THE DEFINITION FOR COMPOSTED MATERIALS AS DEFINED BY THE WASHINGTON STATE DEPARTMENT OF ECOLOGY.

D. SOIL AMENDMENTS (BUFFER AREAS ONLY):

D.A. FERTILIZER: WOODY PLANTINGS SHALL BE FERTILIZED WITH A SLOW-RELEASE GENERAL GRANULAR FERTILIZER (16-16-16), WITH APPLICATION RATES AS SPECIFIED BY MANUFACTURER. FERTILIZER SHALL BE APPLIED AFTER PLANTING PIT IS BACKFILLED, AND PRIOR TO APPLICATION OF MULCH. FERTILIZER SHALL NOT BE APPLIED BETWEEN NOVEMBER AND MARCH. NO FERTILIZER SHALL BE APPLIED WITHIN WETLAND AREAS.

D.B. SOIL MOISTURE RETENTION AGENT: A SOIL MOISTURE RETENTION AGENT, SUCH AS "SOILMOIST" OR EQUAL, SHALL BE INCORPORATED INTO THE BACKFILL OF EACH PLANTING PIT, PER MANUFACTURER'S INSTRUCTIONS. NO MOISTURE RETENTION AGENT SHALL BE APPLIED WITHIN WETLAND AREAS.

2.3 MULCH

A. BARK OR WOODCHIP MULCH SHALL BE DERIVED FROM DOUGLAS FIR, PINE, OR HEMLOCK SPECIES. THE MULCH SHALL NOT CONTAIN RESIN, TANNIN, OR OTHER COMPOUNDS IN QUANTITIES THAT WOULD BE DETRIMENTAL TO ANIMAL, PLANT LIFE, OR WATER QUALITY. SAWDUST SHALL NOT BE USED AS MULCH.

B. MULCH SHALL BE MEDIUM-COARSE GROUND WITH AN APPROXIMATELY 3-INCH MINUS PARTICLE SIZE. FINE PARTICLES SHALL BE MINIMIZED SO THAT NOT MORE THAN 30%, BY LOOSE VOLUME, WILL PASS THROUGH A US NO. 4 SIEVE.

2.4 MISCELLANEOUS MATERIALS

A. STAKES, DEADMEN AND GUY STAKES: SOUND, DURABLE, WESTERN RED CEDAR, OR OTHER APPROVED WOOD, FREE OF INSECT OR FUNGUS INFESTATION.

B. CHAIN-LOCK TREE TIES: ½-INCH WIDE, PLASTIC.

PART 3: EXECUTION

3.1 SOIL PREPARATION

A. PLANTING AREA CONDITIONS: CONTRACTOR SHALL VERIFY THAT PLANT INSTALLATION CONDITIONS ARE SUITABLE WITHIN THE PROJECT AREA(S). ANY UNSATISFACTORY CONDITIONS SHALL BE CORRECTED PRIOR TO START OF WORK. WHEN CONDITIONS DETRIMENTAL TO PLANT GROWTH ARE ENCOUNTERED, SUCH AS RUBBLE FILL, POOR DRAINAGE, COMPACTED SOILS, SIGNIFICANT EXISTING OR INVASIVE VEGETATION, OR OTHER OBSTRUCTIONS, CONTRACTOR SHALL NOTIFY THE PROJECT BIOLOGIST OR ECOLOGIST PRIOR TO PLANTING. THE BEGINNING OF WORK BY THE CONTRACTOR CONSTITUTES ACCEPTANCE OF CONDITIONS AS SATISFACTORY.

B. PLANTING IN UNDISTURBED, NON-GRADED AREAS: PLANTS INSTALLED IN UNDISTURBED AREAS SHALL BE INTEGRATED WITH EXISTING NATIVE VEGETATION AND PLANTED IN A RANDOM, NATURALISTIC PATTERN. PRIOR TO INSTALLATION OF PLANTINGS, ALL CONSTRUCTION DEBRIS, TRASH, AND NON-NATIVE INVASIVE PLANT MATERIAL SHALL BE REMOVED FROM THE PROJECT AREA. IN NON-GRADED AREAS, TREES AND SHRUBS SHALL BE PIT PLANTED AS SHOWN IN TYPICAL PLANTING DETAILS. PLANTING PITS SHALL BE BACKFILLED WITH A 50/50 MIXTURE OF IMPORTED, WEED-FREE TOPSOIL AND THE SOIL FROM THE PLANTING PIT.

C. PLANTING IN GRADED AREAS: IN GRADED PLANTING AREAS PLANTS SHALL BE INSTALLED IN NEWLY PLACED TOPSOIL.

D. SOIL DECOMPACTION/SCARIFICATION: SOILS IN GRADED/DISTURBED AREAS THAT ARE COMPACTED AND UNSUITABLE FOR PROPER PLANT GROWTH SHALL BE DECOMPACTED AND/OR SCARIFIED TO A MINIMUM DEPTH OF 6" PRIOR TO TOPSOIL INSTALLATION.

3.2 PLANTING

A. PLANT LAYOUT: PROPOSED LOCATIONS OF TREES AND SHRUBS SHALL BE STAKED AND IDENTIFIED WITH AN APPROVED CODING SYSTEM OR BY PLACEMENT OF THE ACTUAL PLANT MATERIAL. FOR LARGE GROUPINGS OF A SINGLE SPECIES OF SHRUB, LANDSCAPE CONTRACTOR MAY STAKE THE PLANTING BOUNDARIES.

B. OBTAIN LAYOUT APPROVAL FROM THE PROJECT BIOLOGIST OR ECOLOGIST PRIOR TO EXCAVATION OF PLANTING PITS.

C. PLANTING PIT DIMENSIONS:

1. PIT DEPTH: NOT TO EXCEED THE ROOT BALL OR CONTAINER DEPTH.
2. PIT WIDTH: MEASURED AT THE GROUND SURFACE, 2 TIMES THE WIDTH OF THE ROOT BALL OR CONTAINER, AS INDICATED IN TYPICAL PLANTING DETAILS.
   a. BARE-ROOT PLANTS: DIAMETER EQUAL TO THE WIDTH OF THE ROOT SPREAD.

D. SETTING PLANTS:

1. BALLED PLANTS: SET PLANTS IN POSITION AND BACKFILL 1/2 DEPTH OF BALL. COMPLETELY REMOVE CAGE AND TWINE FROM PLANT AND PULL BURLAP DOWN AS FAR AS POSSIBLE. COMPLETE BACKFILL AND SETTLE WITH WATER. ROOT COLLAR SHALL REMAIN 1 INCH ABOVE ADJACENT GRADE.
2. BARE-ROOT PLANTS: PRUNE BRUISED OR BROKEN ROOTS. SET PLANT IN POSITION AND PLACE WETLAND PLANTING SOIL AROUND ROOTS. USE CARE TO AVOID BRUISING OR BREAKING ROOTS WHEN FIRMING SOIL. SETTLE WITH WATER.
3. SHRUB/TREE PLANTING: SHRUB AND TREE STOCK SHALL BE PLANTED IN HAND-DUG HOLES ACCORDING TO PLANTING DETAILS SHOWN ON THE MITIGATION PLANS. SHRUB AND TREE ROOT BALLS SHALL BE SET SO THAT ROOT COLLARS ARE 1 INCH ABOVE ADJACENT GRADE. ALL BACKFILL SHALL BE GENTLY TAMPED IN PLACE.
4. SURFACE FINISH: FORM A SAUCER AS INDICATED ON TYPICAL PLANTING DETAILS, OR AS DIRECTED. GRADE SOIL TO FORM A BASIN ON THE LOWER SIDE OF SLOPE PLANTINGS TO CATCH AND RETAIN WATER.
5. IN FORESTED AREAS, CONTRACTOR SHALL LOOSELY TIE A 2 FOOT PIECE OF BIODEGRADABLE FLAGGING TO THE TOP PORTION OF ALL PLANTED VEGETATION, BUT NOT ON A CENTRAL LEADER, TO FACILITATE POST-CONSTRUCTION PERFORMANCE AND MAINTENANCE REVIEW BY THE PROJECT BIOLOGIST OR ECOLOGIST AND REGULATORY AGENCIES.
6. ACTUAL PLANT SYMBOL QUANTITIES SHOWN ON THE PLANS SHALL PREVAIL OVER QUANTITIES SHOWN ON THE PLANT SCHEDULE IN THE EVENT OF A DISCREPANCY.

E. MULCHING:

1. GRADED BUFFER AREAS: ARE MULCHED PRIOR TO PLANT INSTALLATION AS DIRECTED IN THE GRADING SPECIFICATIONS.
2. NON-GRADED BUFFER AREAS: PROVIDE A 36-INCH DIAMETER, 3-INCH DEEP MULCH RING AROUND THE BASE OF EACH TREE, AND A 24-INCH DIAMETER, 3-INCH DEEP MULCH RING AROUND THE BASE OF EACH SHRUB.
3. WATER PLANTS THOROUGHLY AFTER MULCHING.

F. PRUNING: PRUNE IMMEDIATELY AFTER PLANTING ONLY AS DIRECTED BY THE PROJECT BIOLOGIST OR ECOLOGIST.

G. TREE STAKES AND TIES: STAKE DECIDUOUS AND EVERGREEN TREES 4 FEET OR OVER IN HEIGHT WITH ONE (1) STAKE PER TREE. STAKE TREES IMMEDIATELY AFTER PLANTING. PLACE STAKE AT THE OUTER EDGE OF THE ROOTS OR BALL, IN LINE WITH THE PREVAILING WIND, AND AT A 10 DEGREE ANGLE FROM THE TREE TRUNK. LOOSELY ATTACH STAKE TO TREE USING CHAIN-LOCK TIES; TREE SHOULD BE ABLE TO SWAY.

H. INSTALLING TEMPORARY IRRIGATION

1. GENERAL REQUIREMENTS: CONTRACTOR SHALL PROVIDE AN ABOVE-GROUND TEMPORARY IRRIGATION SYSTEM CAPABLE OF FULL HEAD-TO-HEAD COVERAGE OF ALL PLANTED PROJECT AREAS. THE TEMPORARY IRRIGATION SYSTEM SHALL EITHER UTILIZE CONTROLLER AND POINT OF CONNECTION (POC) FROM THE SITE IRRIGATION SYSTEM OR SHALL INCLUDE A SEPARATE POC AND CONTROLLER WITH A BACKFLOW PREVENTION DEVICE PER WATER JURISDICTION INSPECTION AND APPROVAL. THE SYSTEM SHALL BE ZONED TO PROVIDE OPTIMAL PRESSURE AND UNIFORMITY OF COVERAGE, AS WELL AS SEPARATION BETWEEN AREAS OF FULL SUN AND SHADE AND FOR SLOPES IN EXCESS OF 5 PERCENT. THE SYSTEM SHALL BE OPERATIONAL FOR A MINIMUM OF THE FIRST TWO GROWING SEASONS AFTER PLANTING (THE FIRST TWO YEARS OF THE PERFORMANCE MONITORING PERIOD), OR LONGER IF REQUIRED TO ENSURE PROPER PLANT ESTABLISHMENT. THE SYSTEM SHALL BE REMOVED UPON FINAL APPROVAL OF THE MITIGATION PROJECT AT THE END OF THE PERFORMANCE MONITORING PERIOD.
2. SYSTEM DESIGN AND MATERIALS: ELECTRONIC VALVES SHALL BE THE SAME MANUFACTURER AS THOSE USED FOR THE SITE IRRIGATION SYSTEM, OR SHALL BE RAIN BIRD PEB SERIES OR EQUAL IF SYSTEM IS NOT CONTIGUOUS WITH THE SITE SYSTEM. VALVES SHALL BE SIZED TO ACCOMMODATE PRESSURE AND ZONE CONSUMPTION REQUIREMENTS OF THE SYSTEM AND SHALL BE INSTALLED BELOW GRADE IN CARSON (OR EQUAL) VALVE BOXES. WIRING SHALL BE INSULATED MULTI-STRAND, TAPED TO THE MAIN AT 6-INCH INTERVALS WITH DUCT TAPE WRAPS. ON-GRADE MAIN AND LATERAL LINES SHALL BE CLASS 200 PVC BELL PIPE WITH SOLVENT WELDED FITTINGS, SECURED IN-PLACE WITH WIRE STAPLES WHERE NECESSARY ON SLOPED AREAS. LINES SHALL BE PLACED 12 INCHES BELOW GRADE IN 4 INCH PCV SLEEVES WHERE VEHICULAR OR MAINTENANCE ACCESS IS NEEDED ACROSS LINES TO THE PROJECT AREA(S). MAXIMUM MAIN LINE SIZE SHALL BE 1½ INCHES AND MAY BE LOOPED BACK TO THE POC TO REDUCE PRESSURE LOSS. LATERAL LINES SHALL BE SIZED IN DECREASING DOWNSTREAM ORDER PER RAIN BIRD DESIGN STANDARDS; THE MINIMUM LATERAL SIZE SHALL BE ¾ INCH. HEADS SHALL BE ROTOR OR IMPACT TYPE INSTALLED 4 FEET ABOVE FINISHED GRADE ON 2-INCH DIAMETER WOOD TREE STAKES. STAKES SHALL BE SECURE IN THE GROUND, EMBEDDED TO A MINIMUM DEPTH OF 24 INCHES. HEADS AND ¾ INCH PVC RISERS SHALL BE SECURED TO STAKES WITH CONSTRICTING HOSE CLAMPS; NO FUNNY PIPE SHALL BE USED. HEADS AND NOZZLES SHALL PROVIDE MATCHED PRECIPITATION RATES FOR EACH ZONE.
3. PROGRAMMING: IRRIGATION SYSTEM SHALL BE PROGRAMMED TO PROVIDE APPROXIMATELY 1/2 INCH OF WATER EVERY THREE DAYS DURING THE DRY SEASON (APPROXIMATELY JUNE 15TH TO OCTOBER 15TH). IRRIGATION AMOUNTS IN ZONES LOCATED IN THE SHADE OR ON STEEP SLOPES MAY BE REDUCED IF APPROVED BY THE PROJECT BIOLOGIST OR ECOLOGIST OR THE PROJECT ECOLOGIST/BIOLOGIST.
4. WATER AND POWER SUPPLY FOR SYSTEM: THE OWNER SHALL PROVIDE WATER AND ELECTRICITY FOR THE SYSTEM.
5. AS-BUILT DRAWING: A CHART DESCRIBING THE LOCATION OF ALL INSTALLED OR OPEN ZONES AND CORRESPONDING CONTROLLER NUMBERS SHALL BE PROVIDED BY THE CONTRACTOR AND PLACED INSIDE THE CONTROLLER AND GIVEN TO THE OWNER'S REPRESENTATIVE.
6. WARRANTY: THE IRRIGATION SYSTEM SHALL INCLUDE A ONE-YEAR WARRANTY AGAINST DEFECTS IN MATERIALS AND WORKMANSHIP FROM THE DATE OF FINAL PROJECT ACCEPTANCE. THE WARRANTY SHALL INCLUDE SYSTEM ACTIVATION AND WINTERIZATION FOR THE FIRST YEAR AND IMMEDIATE REPAIR OF THE SYSTEM IF IT IS OBSERVED TO BE MALFUNCTIONING.

J. CRITICAL AREAS FENCE AND SIGNS: INSTALL CRITICAL AREAS FENCE AND CRITICAL AREAS SIGNS WHERE SHOWN ON PLANS.

K. RESTORE EXISTING NATURAL OR LANDSCAPED AREAS:

1. EXISTING NATURAL OR LANDSCAPED AREAS THAT ARE DAMAGED DURING CONSTRUCTION SHALL BE RESTORED TO THEIR ORIGINAL CONDITION, UNLESS IMPROVEMENTS OR MODIFICATIONS ARE SPECIFIED FOR THOSE AREAS.
2. CONTRACTOR SHALL EXERCISE CARE TO PREVENT INJURY TO THE TRUNK, ROOTS, OR BRANCHES OF ANY TREES OR SHRUBS THAT ARE TO REMAIN. ANY LIVING, WOODY PLANT THAT IS DAMAGED DURING CONSTRUCTION SHALL BE TREATED WITHIN 24 HOURS OF OCCURRENCE, AND THE PROJECT BIOLOGIST OR ECOLOGIST SHALL BE NOTIFIED IMMEDIATELY OF THE INCIDENT. DAMAGE TREATMENT SHALL INCLUDE EVENLY CUTTING BROKEN BRANCHES, BROKEN ROOTS, AND DAMAGED TREE BARK. INJURED PLANTS SHALL BE THOROUGHLY WATERED AND ADDITIONAL MEASURES SHALL BE TAKEN, AS APPROPRIATE, TO AID IN PLANT SURVIVAL.

L. FINAL INSPECTION AND APPROVAL: THE CONTRACTOR SHALL NOTIFY THE PROJECT BIOLOGIST OR ECOLOGIST IN WRITING AT LEAST TEN DAYS PRIOR TO THE REQUESTED DATE OF A PROJECT COMPLETION INSPECTION. IF ITEMS ARE TO BE CORRECTED, A PUNCH LIST SHALL BE PREPARED BY THE PROJECT BIOLOGIST OR ECOLOGIST AND SUBMITTED TO THE CONTRACTOR FOR COMPLETION. AFTER PUNCH LIST ITEMS HAVE BEEN COMPLETED, THE PROJECT BIOLOGIST OR ECOLOGIST SHALL REVIEW THE PROJECT AGAIN FOR FINAL ACCEPTANCE OF PLAN IMPLEMENTATION. IF PUNCH LIST ITEMS REQUIRE PLANT REPLACEMENT, AND THE INSPECTION OCCURS OUTSIDE OF A SUITABLE PLANTING SEASON, PLANTS SHALL BE REPLACED DURING THE NEXT PLANTING SEASON.

M. AS-BUILT PLAN: CONTRACTOR IS RESPONSIBLE FOR VERIFYING PLANT LOCATIONS AND QUANTITIES ON THE PLANT SCHEDULE WITH THOSE REPRESENTED AS SYMBOLS ON THE MITIGATION PLANS. CONTRACTOR SHALL KEEP A COMPLETE SET OF PRINTS AT THE JOB SITE DURING CONSTRUCTION FOR THE PURPOSE OF RECORDING IN-THE-FIELD CHANGES OR MODIFICATIONS TO THE APPROVED PLANS. THIS INFORMATION SHALL BE UPDATED ON A DAILY BASIS AS NECESSARY.

PART 4: ONE YEAR CONTRACTOR WARRANTY

NOTE: THESE MAINTENANCE SPECIFICATIONS APPLY TO THE ONE-YEAR CONTRACTOR WARRANTY PERIOD ONLY. IF THIS MITIGATION PROJECT REQUIRES LONG-TERM PERFORMANCE MONITORING, AS DETERMINED BY THE GOVERNING JURISDICTION, THE MAINTENANCE SPECIFICATIONS AND GUIDELINES ASSOCIATED WITH THE PERFORMANCE MONITORING STANDARDS ARE INCLUDED IN THE MITIGATION REPORT ASSOCIATED WITH THIS PLAN SET, AND MAY ALSO BE INCLUDED ON A SEPARATE PLAN SHEET IF REQUIRED.

A. REVIEW OF MAINTENANCE REQUIREMENTS: CONTRACTOR SHALL REVIEW LANDSCAPE MAINTENANCE RECOMMENDATIONS WITH A QUALIFIED WETLAND BIOLOGIST FROM THE PROJECT BIOLOGIST OR ECOLOGIST WHO IS FAMILIAR WITH THE STATED GOALS AND OBJECTIVES OF THE PROJECT PLAN.

B. MAINTENANCE ACTIVITIES: CONTRACTOR SHALL MAINTAIN TREES AND SHRUBS FOR A PERIOD OF ONE YEAR FROM THE DATE OF FINAL ACCEPTANCE IN ORDER TO MAINTAIN HEALTHY GROWTH AND HABITAT DIVERSITY. MAINTENANCE ACTIVITIES SHALL INCLUDE, BUT ARE NOT LIMITED TO: (A) REPLACING PLANTS DUE TO MORTALITY, (B) TIGHTENING AND REPAIRING TREE STAKES, (C) RESETTING PLANTS TO PROPER GRADES AND UPRIGHT POSITIONS, AND (D) CORRECTING DRAINAGE PROBLEMS AS REQUIRED.

C. IRRIGATION:

1. SYSTEM MAINTENANCE AND REPAIR: THE CONTRACTOR SHALL BE RESPONSIBLE FOR ACTIVATING, WINTERIZING, MAINTAINING, AND CONTINUALLY VERIFYING THE ADEQUATE OPERATION OF THE TEMPORARY IRRIGATION SYSTEM FOR THE FIRST GROWING SEASON FOLLOWING INSTALLATION. SYSTEM FUNCTION (INCLUDING ELECTRONIC VALVE AND CONTROLLER FUNCTION) SHALL BE INSPECTED FOR OPERATION AND FULL COVERAGE OF ALL PLANTED AREAS DURING EACH MAINTENANCE VISIT. THE SYSTEM SHALL BE REPAIRED IMMEDIATELY IF FOUND TO BE DAMAGED OR MALFUNCTIONING. SYSTEM SHALL BE PROGRAMMED AND MAINTAINED TO PROVIDE APPROXIMATELY ½ INCH OF WATER EVERY THREE DAYS.

D. STAKE AND TIE REMOVAL: CONTRACTOR SHALL REMOVE TREE STAKES AND TIES ONE YEAR AFTER INSTALLATION, UNLESS RECEIVING WRITTEN PERMISSION FROM THE PROJECT BIOLOGIST OR ECOLOGIST TO DELAY REMOVAL OF STAKES AND TIES

E. EROSION AND DRAINAGE: CONTRACTOR SHALL CORRECT EROSION AND DRAINAGE PROBLEMS AS REQUIRED.

F. IRRIGATION SYSTEM REMOVAL: CONTRACTOR SHALL REMOVE IRRIGATION SYSTEM APPROXIMATELY 2 YEARS AFTER PLANTING, OR AS APPROVED BY THE PROJECT BIOLOGIST OR ECOLOGIST.

G. FINAL MAINTENANCE INSPECTION AND APPROVAL: UPON COMPLETION OF THE ONE-YEAR MAINTENANCE PERIOD, AN INSPECTION BY THE PROJECT BIOLOGIST OR ECOLOGIST SHALL BE CONDUCTED TO CONFIRM THAT THE PROJECT AREA WAS PROPERLY MAINTAINED. IF ITEMS ARE TO BE CORRECTED, A PUNCH LIST SHALL BE PREPARED AND SUBMITTED TO THE CONTRACTOR FOR CORRECTION. UPON CORRECTION OF THE PUNCH LIST ITEMS, THE PROJECT SHALL BE REVIEWED BY THE PROJECT BIOLOGIST OR ECOLOGIST FOR FINAL CLOSEOUT OF PLAN IMPLEMENTATION.

H. ADD THE FOLLOWING NOTE IF NO IRRIGATION WILL BE INSTALLED:
WATERING: THE CONTRACTOR SHALL PROVIDE MANUAL WATERING OF THE MITIGATION PLANTINGS BETWEEN JUNE 15TH AND OCTOBER 15TH. SUPPLEMENTAL WATERING MAY ALSO BE REQUIRED IF HOT, DRY WEATHER OCCURS EITHER BEFORE OR AFTER THESE DATES. DURING THE FIRST YEAR AFTER INSTALLATION, PLANTINGS SHALL BE WATERED A MINIMUM OF ONE INCH PER WEEK. WATERING FREQUENCY MAY BE INCREASED AS NECESSARY DURING PROLONGED PERIODS OF HOT, DRY WEATHER TO PREVENT PLANT MORTALITY.

THIS DEVELOPMENT SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE CITY OF REDMOND STANDARD SPECIFICATIONS AND DETAILS, CURRENT EDITION.

811 Know what's below. Call before you dig.

NOTES

1. SURVEY PROVIDED BY BRH, INC., 2009 MINOR AVENUE EAST SEATTLE, WA 98102, (206) 323-4144.
2. SITE PLAN PROVIDED BY CPL, INC., 801 SECOND AVENUE, SUITE 900, SEATTLE, WA 98104, (206) 343-0460.
3. SOURCE DRAWING WAS MODIFIED BY TALASAEA CONSULTANTS FOR VISUAL ENHANCEMENT.
4. THIS PLAN IS AN ATTACHMENT TO THE CRITICAL AREAS REPORT PREPARED BY TALASAEA CONSULTANTS IN OCTOBER, 2019.

TALASAEA CONSULTANTS, INC.
Resource & Environmental Planning
15020 Bear Creek Road Northeast - Woodinville, Washington 98077
Bus (425) 861-7550 - Fax (425) 861-7549

CRITICAL AREAS DETAILED MITIGATION PLAN
PLANTING SPECIFICATIONS
BUILDING X PROJECT
REDMOND, WASHINGTON

Revisions	Date	By
CITY COMMENTS	6-5-2019	FH
CITY COMMENTS	10-10-2019	MW
SITE PLAN ENTITLEMENT	10-18-2019	MW

Date	2-6-2019
Scale	AS NOTED
Designed	AO
Drawn	MW/FH
Checked	AO
Approved	BS

Project # 1732

Sheet # W4.0

Appendix B:

Wetland Determination Data Forms, Talasaea Consultants, 2018/2019

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: TAL-1732 City/County: Redmond/King Sampling Date: 9/24/2018

Applicant/Owner: Willow Run, LLC. State: WA Sampling Point: TP-UPL-1

Investigator(s): KM Section, Township, Range: SE 1/4 S34, T26N, R05E, W.M.

Landform (hillslope, terrace, etc.): Hillsope Local relief (concave, convex, none): Concave Slope (%): 5

Subregion (LRR): A Lat: 47.69073 Long: -122.15334 W Datum: NAD83

Soil Map Unit Name: Alderwood gravelly sandy loam, 8-15% slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☐ No ☒ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☐ No ☒ Hydric Soil Present? Yes ☐ No ☒ Wetland Hydrology Present? Yes ☐ No ☒	**Is the Sampled Area within a Wetland?** Yes ☐ No ☒

Remarks: Located South of South Building, near the southern property line, east of TP-W3-1. Drier than normal.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 5m)	Absolute % Cover	Dominant Species?	Indicator Status
1. *None*			
2.			
3.			
4.			
	0 = Total Cover		
Sapling/Shrub Stratum (Plot size: 3m)			
1. *Acer circinatum*	15	Yes	FAC
2. *Rubus spectabilis*	20	Yes	FAC
3. *Rubus armeniacus*	20	Yes	FAC
4.			
5.			
	55 = Total Cover		
Herb Stratum (Plot size: 1m)			
1. *Polystichum munitum*	10	Yes	FACU
2. *Urtica dioica*	5	No	FAC
3. *Rubus ursinus*	15	Yes	FACU
4.			
5.			
6.			
7.			
8.			
	30 = Total Cover		
Woody Vine Stratum (Plot size: 3m)			
1. *None.*			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 0 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 60 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

☒ Dominance Test is >50%

☐ Prevalence Index is ≤3.0[1]

☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ☒ **No** ☐

Remarks: Vegetation was dominated by FAC and drier species.

SOIL

Sampling Point: TP-UPL-1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
4-12	10YR 2/2	100		-	-	-	Sandy Loam	Humus (dried wood) at surface
12-22	10YR 3/2	100	-	-	-	-	Sandy Loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1 (**except MLRA 1**))
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ☐ No ☒

Remarks: No hydric soil indicators were met. The soil is not considered to be hydric.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1)(**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B)**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6(**LRR A**)
- ☐Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches): _____

Water Table Present? Yes ☐ No ☒ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches): _____

Wetland Hydrology Present? Yes ☐ No ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: No wetland hydrology indicators were met. Soil was moist at 15" depth, but not saturated.

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: TAL-1732 City/County: Redmond/King Sampling Date: 9/24/2018

Applicant/Owner: Willow Run, LLC. State: WA Sampling Point: TP-UPL-2

Investigator(s): KM Section, Township, Range: SE 1/4 S34, T26N, R05E, W.M.

Landform (hillslope, terrace, etc.): Hillslope Local relief (concave, convex, none): _____ Slope (%): 10

Subregion (LRR): A Lat: 47.692208 Long: -122.154509 Datum: NAD83

Soil Map Unit Name: Alderwood gravelly sandy loam, 8-15% slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☐ No ☒ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☒ No ☐ Hydric Soil Present? Yes ☐ No ☒ Wetland Hydrology Present? Yes ☐ No ☒	**Is the Sampled Area within a Wetland?** Yes ☐ No ☒

Remarks: Drier than normal conditions. Wetland located to the west of Project Site and TP-UPL-3.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 5m)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Thuja plicata*	60	Yes	FAC
2. *Populus balsamifera*	5	No	FAC
3. *Acer macrophyllum*	10	No	FAC
4.			
	75	= Total Cover	
Sapling/Shrub Stratum (Plot size: 3m)			
1. *Rubus spectabilis*	10	Yes	FAC
2. *Ribes bracteosum*	15	Yes	FAC
3.			
4.			
5.			
	25	= Total Cover	
Herb Stratum (Plot size: 1m)			
1. *Athyrium filix-femina*	10	Yes	FAC
2. *Polystichum munitum*	10	Yes	FACU
3. *Rubus ursinus*	30	Yes	FACU
4.			
5.			
6.			
7.			
8.			
	50	= Total Cover	
Woody Vine Stratum (Plot size: 3m)			
1. *None.*			
2.			
	0	= Total Cover	

% Bare Ground in Herb Stratum 0 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 67 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

☒ Dominance Test is >50%

☐ Prevalence Index is ≤3.0[1]

☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ☒ **No** ☐

Remarks: Although the plant community meets the criteria for hydrophytic vegetation, ony plants with FAC or drier wetland indicator status were identified.

SOIL

Sampling Point: TP-UPL-2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-10	10YR 2/2	100	-	-	-	-	Loam	
10-20	10YR 4/4	100	-	-	-	-	Loam	Rich color

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1 (**except MLRA 1**))
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ☐ No ☒

Remarks: Soil was typical of upland conditions. No hydric soil indicators were met.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1)(**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B)**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6(**LRR A**)
- ☐Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches): _____

Water Table Present? Yes ☐ No ☒ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches): _____

Wetland Hydrology Present? Yes ☐ No ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Soil was dry to 20". No hydric soil indicators were met.

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: TAL-1732 City/County: Redmond/King Sampling Date: 9/24/2018

Applicant/Owner: Willow Run, LLC. State: WA Sampling Point: TP-UPL-3

Investigator(s): KM Section, Township, Range: SE 1/4 S34, T26N, R05E, W.M.

Landform (hillslope, terrace, etc.): hillslope Local relief (concave, convex, none): None Slope (%): 10

Subregion (LRR): A Lat: 47.691986 Long: -122.154007 Datum: NAD83

Soil Map Unit Name: Alderwood gravelly sandy loam, 8-15% slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☐ No ☒ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☐ No ☒ Hydric Soil Present? Yes ☐ No ☒ Wetland Hydrology Present? Yes ☐ No ☒	**Is the Sampled Area within a Wetland?** Yes ☐ No ☒

Remarks: Drier than normal conditions. Sample plot located west of the central developed area of Project Site and east of TP-UPL-2.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 5m)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer macrophyllum*	60	Yes	FACU
2. *Populus balsamifera*	30	Yes	FAC
3.			
4.			
	90 = Total Cover		
Sapling/Shrub Stratum (Plot size: 3m)			
1. *Rubus spectabilis*	70	Yes	FAC
2.			
3.			
4.			
5.			
	70 = Total Cover		
Herb Stratum (Plot size: 1m)			
1. *Rubus ursinus*	40	Yes	FACU
2. *Dicentra formosa*	15	Yes	FACU
3. *Tellima grandiflora*	15	Yes	FACU
4. *Geranium robertianum*	5	No	FACU
5.			
6.			
7.			
8.			
	75 = Total Cover		
Woody Vine Stratum (Plot size: 3m)			
1. *None.*			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 0 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ☐ **No** ☒

Remarks: Vegetation typical of upland conditions. Criteria for hydrophytic vegetation were not met.

SOIL

Sampling Point: TP-UPL-3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-13	10YR 2/2	100	-	-	-	-	Sandy Loam	
13-20	10YR 3/4	100	-	-	-	-	Sandy Loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1 (**except MLRA 1**))
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ☐ No ☒

Remarks: Soil did not meet any hydric soil indicators. Soils typical of upland conditions.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1)(**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B)**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6(**LRR A**)
- ☐Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches): _____

Water Table Present? Yes ☐ No ☒ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches): _____

Wetland Hydrology Present? Yes ☐ No ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Soil was moist, not saturated, at 18" below surface. No wetland hydrology indicators were met.

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: TAL-1732 City/County: Redmond/King Sampling Date: 9/24/2018

Applicant/Owner: Willow Run, LLC. State: WA Sampling Point: TP-UPL-4

Investigator(s): KM Section, Township, Range: SE 1/4 S34, T26N, R05E, W.M.

Landform (hillslope, terrace, etc.): hillslope Local relief (concave, convex, none): None Slope (%): 10

Subregion (LRR): A Lat: 47.692217 Long: -122.154037 Datum: NAD83

Soil Map Unit Name: Alderwood gravelly sandy loam, 8-15% slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☐ No ☒ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☐ No ☒ Hydric Soil Present? Yes ☐ No ☒ Wetland Hydrology Present? Yes ☐ No ☒	**Is the Sampled Area within a Wetland?** Yes ☐ No ☒

Remarks: Drier than normal conditions. Sample Point located west of developed area of the Site and north of TP-UPL-2 and TP-UPL-3.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 5m)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer macrophyllum*	80	Yes	FACU
2.			
3.			
4.			
	80 = Total Cover		
Sapling/Shrub Stratum (Plot size: 3m)			
1. *Oemleria cerasiformis*	25	Yes	FACU
2. *Rubus spectabilis*	25	Yes	FAC
3.			
4.			
5.			
	50 = Total Cover		
Herb Stratum (Plot size: 1m)			
1. *Dicentra formosa*	15	Yes	FACU
2. *Rubus ursinus*	40	Yes	FACU
3. *Polystichum munitum*	15	Yes	FACU
4.			
5.			
6.			
7.			
8.			
	70 = Total Cover		
Woody Vine Stratum (Plot size: 3m)			
1. *None.*			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 0 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 17 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ☐ **No** ☒

Remarks: Vegetation typical of upland conditions. No hydrophytic vegetation criteria were met.

SOIL

Sampling Point: TP-UPL-4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0-20	10YR 3/3	100	-	-	-	-	Sandy Loam	Gravel at 12" depth

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1 (**except MLRA 1**))
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ☐ No ☒

Remarks: No hydric soil indicators were met. Soil typical of upland conditions.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1)(**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B)**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6(**LRR A**)
- ☐Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches): _____

Water Table Present? Yes ☐ No ☒ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches): _____

Wetland Hydrology Present? Yes ☐ No ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: No wetland hydrology indicators were met. Hydrology was typical of upland conditions.

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: TAL-1732 City/County: Redmond/King Sampling Date: 9/24/2018

Applicant/Owner: Willow Run, LLC. State: WA Sampling Point: TP-UPL-5

Investigator(s): KM Section, Township, Range: SE 1/4 S34, T26N, R05E, W.M.

Landform (hillslope, terrace, etc.): hillslope Local relief (concave, convex, none): none Slope (%): 10

Subregion (LRR): A Lat: 47.692916 Long: -122.154251 Datum: NAD83

Soil Map Unit Name: Alderwood gravelly sandy loam, 8-15% slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☐ No ☒ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☒ No ☐ Hydric Soil Present? Yes ☐ No ☒ Wetland Hydrology Present? Yes ☐ No ☒	**Is the Sampled Area within a Wetland?** Yes ☐ No ☒

Remarks: Drier than normal conditions. Sample point located NW of developed area of Site, west of TP-UPL-6.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 5m)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Alnus rubra*	80	Yes	FAC
2.			
3.			
4.			
	80 = Total Cover		
Sapling/Shrub Stratum (Plot size: 3m)			
1. *Rubus spectabilis*	80	Yes	FAC
2.			
3.			
4.			
5.			
	80 = Total Cover		
Herb Stratum (Plot size: 1m)			
1. *Tellima grandiflora*	20	Yes	FACU
2. *Athyrium filix-femina*	5	Yes	FAC
3.			
4.			
5.			
6.			
7.			
8.			
	25 = Total Cover		
Woody Vine Stratum (Plot size: 3m)			
1. *None.*			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum 75 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

☒ Dominance Test is >50%

☐ Prevalence Index is ≤3.0[1]

☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes ☒ No ☐**

Remarks: Although the vegetation community met the criteria for being hydrophytic, only FAC and drier species were present.

SOIL

Sampling Point: TP-UPL-5

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0-11	10YR 3/1	100	-	-	-	-	Loam	
11-20	10YR 4/3	100	-	-	-	-	Sandy Loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1 (**except MLRA 1**))
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ☐ No ☒

Remarks: Soil typical of upland conditions.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1)(**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B)**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6(**LRR A**)
- ☐Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches): _____

Water Table Present? Yes ☐ No ☒ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches): _____

Wetland Hydrology Present? Yes ☐ No ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: No indicators of wetland hydrology were identified.

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: TAL-1732 City/County: Redmond/King Sampling Date: 9/24/2018

Applicant/Owner: Willow Run, LLC. State: WA Sampling Point: TP-UPL-6

Investigator(s): KM Section, Township, Range: SE 1/4 S34, T26N, R05E, W.M.

Landform (hillslope, terrace, etc.): HIllslope Local relief (concave, convex, none): Concave Slope (%): 5

Subregion (LRR): A Lat: 47.6930 Long: -122.1539 Datum: NAD83

Soil Map Unit Name: Alderwood gravelly sandy loam, 8-15% slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☐ No ☒ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☒ No ☐ Hydric Soil Present? Yes ☐ No ☒ Wetland Hydrology Present? Yes ☐ No ☒	**Is the Sampled Area within a Wetland?** Yes ☐ No ☒

Remarks: Drier than normal conditions. Sample plot located NW of developed site area, east of TP-UPL-5

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 5m)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	0 = Total Cover		
Sapling/Shrub Stratum (Plot size: 3m)			
1. *Rubus armeniacut*	60	Yes	FAC
2. *Rubus spectabilis*	40	Yes	FAC
3.			
4.			
5.			
	100 = Total Cover		
Herb Stratum (Plot size: 1m)			
1. *Athyrium filix-femina*	10	Yes	FAC
2. *Tellima grandiflora*	10	Yes	FACU
3. *Pteridium aquilinum*	5	Yes	FACU
4.			
5.			
6.			
7.			
8.			
	25 = Total Cover		
Woody Vine Stratum (Plot size: 3m)			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 60 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

☒ Dominance Test is >50%

☐ Prevalence Index is ≤3.0[1]

☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ☒ **No** ☐

Remarks: Rubus armeniacus is very think and growing over R. spectabilis in a thick hedge. Although the vegetation community met the criteria for hydrophytic vegetation, only FAC and drier species are present.

SOIL

Sampling Point: TP-UPL-6

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR 3/2	100					SL	
8-24	10YR 3/4	100					SL	Soil color very rich

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1 (**except MLRA 1**))
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ☐ No ☒

Remarks: Soil did not meet any hydric indicators and is typical of upland conditions.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1)(**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B)**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6(**LRR A**)
- ☐Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches): _____

Water Table Present? Yes ☐ No ☒ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches): _____

Wetland Hydrology Present? Yes ☐ No ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: No wetlnad hydrology indicators were met.

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: TAL-1732 City/County: Redmond/King Sampling Date: 6/12/2018

Applicant/Owner: Willow Run, LLC. State: WA Sampling Point: TP-UPL-7

Investigator(s): KM Section, Township, Range: SE 1/4 S34, T26N, R05E, W.M.

Landform (hillslope, terrace, etc.): Hillsope Local relief (concave, convex, none): Concave Slope (%): 5

Subregion (LRR): A Lat: 47.69073 Long: -122.15334 W Datum: NAD83

Soil Map Unit Name: Alderwood gravelly sandy loam, 8-15% slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☐ No ☒ Hydric Soil Present? Yes ☐ No ☒ Wetland Hydrology Present? Yes ☐ No ☒	**Is the Sampled Area within a Wetland?** Yes ☐ No ☒

Remarks: Located South of South Building, near the southern property line.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 5m)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer macrophyllum*	75	Yes	FACU
2. *Thuja plicata*	20	Yes	FAC
3. *Frangula purshiana*	5	No	FAC
4.			
	100	= Total Cover	
Sapling/Shrub Stratum (Plot size: 3m)			
1. *Rubus spectabilis*	20	Yes	FAC
2. *Acer circinatum*	15	Yes	FAC
3. *Oemleria cerasiformis*	10	Yes	FACU
4.			
5.			
	45	= Total Cover	
Herb Stratum (Plot size: 1m)			
1. *Polystichum munitum*	15	Yes	FACU
2. *Dicentra formosa*	15	Yes	FACU
3. *Rubus ursinus*	15	Yes	FACU
4.			
5.			
6.			
7.			
8.			
	45	= Total Cover	
Woody Vine Stratum (Plot size: 3m)			
1. *None.*			
2.			
	0	= Total Cover	

% Bare Ground in Herb Stratum 0 % Cover of Biotic Crust 0

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 8 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 37.5 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ☐ **No** ☒

Remarks: Herb stratum has duff layer (55%). Hydrophytic vegetation criteria were not met.

SOIL

Sampling Point: TP-UPL-7

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-11	10YR 2/1	100	-	-	-	-	Loamy Sand	Gravel starting at 12" depth
11-20	10YR 3/1	100	-	-	-	-	GLoS*	50% gravels (>3" diameter)

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1 (**except MLRA 1**))
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ☐ No ☒

Remarks: *GLoS = Gravelly, Loamy Sand. No hydric soil indicators were met.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1)(**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B)**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6(**LRR A**)
- ☐Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches): _____

Water Table Present? Yes ☐ No ☒ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches): _____

Wetland Hydrology Present? Yes ☐ No ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Soil was moist, not saturated, at 15" depth from soil surface. No wetland hydrology indicators were met.

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: TAL-1732 Building X Project City/County: Redmond Sampling Date: 24 Sept 2018

Applicant/Owner: OAC State: Washington Sampling Point: TP-X1

Investigator(s): DRT Section, Township, Range: SE 1/4 Section 34, T26N, R5E

Landform (hillslope, terrace, etc.): Hillslope Local relief (concave, convex, none): None Slope (%): 10%

Subregion (LRR): A Lat: 47.6908 Long: -122.1535 Datum: NAD83

Soil Map Unit Name: Alderwood gravelly sandy loam, 8-15% slopes NWI classification: _____

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☐ No ☒ Hydric Soil Present? Yes ☐ No ☒ Wetland Hydrology Present? Yes ☐ No ☒	**Is the Sampled Area within a Wetland?** Yes ☐ No ☒

Remarks: Test plot lacked wetland vegetation, hydrology and soils.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer macrophylllum*	70	Yes	FACU
2. *Thuja plicata*	10		FAC
3. *Pseudotsuga menziesii*	10		FACU
4.			
	90	= Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft)			
1. *Acer circinatum*	40	Yes	FAC
2. *Oemleria cerasiformis*	30	Yes	FACU
3.			
4.			
5.			
	70	= Total Cover	
Herb Stratum (Plot size: 5 ft)			
1. *Tolmiea menziesii*	5	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	2	= Total Cover	
Woody Vine Stratum (Plot size: 15 ft)			
1. *Rubus ursinus*	10	Yes	FACU
2.			
	10	= Total Cover	

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 40 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

- ☐ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ☐ **No** ☒

Remarks: Dominant species not greater than 50% FAC, FACW, or OBL.

SOIL

Sampling Point: TP-X1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0-3	10YR 2/1	100					GSL	Darkened topsoil
3-15	10YR 3/2	100					VGS	Consistency of till or roadbed

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1 (**except MLRA 1**))
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: Gravel

Depth (inches): 15"

Hydric Soil Present? Yes ☐ No ☒

Remarks: The layer under the topsoil is unlike soil found fifteen feet to the north. Test plot soil was either till or old roadbed aggregate. Fifteen feet to the north, the soil contained significantly less gravel and had characteristics of loam. VGS - very gravelly sand. Gravel was not rounded like streambed material would be. Test plot hole stopped at 15 inches due to excessive amounts of imbedded gravel that made digging extraordinarily difficult.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1)(**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B)**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6(**LRR A**)
- ☐Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches): -

Water Table Present? Yes ☐ No ☒ Depth (inches): >15"

Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches): >15"

Wetland Hydrology Present? Yes ☐ No ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: TAL-1732 Building X Project City/County: Redmond Sampling Date: 24 Sept 2018

Applicant/Owner: OAC State: Washington Sampling Point: TP-X2

Investigator(s): DRT Section, Township, Range: SE 1/4 Section 34, T26N, R5E

Landform (hillslope, terrace, etc.): Hillslope Local relief (concave, convex, none): None Slope (%): 10%

Subregion (LRR): A Lat: 47.6908 Long: -122.1531 Datum: NAD83

Soil Map Unit Name: Alderwood gravelly sandy loam, 8-15% slopes NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☐ No ☒ Hydric Soil Present? Yes ☐ No ☒ Wetland Hydrology Present? Yes ☐ No ☒	**Is the Sampled Area within a Wetland?** Yes ☐ No ☒

Remarks: No indications of wetland vegetation, hydrology, or soil.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer macrophyllum*	70	Yes	FACU
2. *Pseudotsuga menziesii*	20		FACU
3.			
4.			
	90	= Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft)			
1. *Acer circinatum*	20		FAC
2. *Rubus spectabilis*	40		FAC
3. *Oemleria cerasiformis*	10		FACU
4.			
5.			
	70	= Total Cover	
Herb Stratum (Plot size: 5 ft)			
1. *Polystichum munitum*	10	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	10	= Total Cover	
Woody Vine Stratum (Plot size: 15 ft)			
1. *Rubus armeniacus*	30	Yes	FAC
2. *Rubus ursinus*	20	Yes	FACU
	50	= Total Cover	

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 25 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ☐ **No** ☒

Remarks: Dominant species are not greater than 50% FAC, FACW, or OBL.

SOIL

Sampling Point: TP-X2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-5	10YR 2/1	100					GSL	Darkened topsoil
5-15	10YR 3/4	100					VGS	Till or roadbed material

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1 (**except MLRA 1**))
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: Gravel

Depth (inches): 15"

Hydric Soil Present? Yes ☐ No ☒

Remarks: Soil texture was almost identical to TP-X1, with the exception of a slightly deeper topsoil layer. Embedded gravel eventually made it extraordinarily difficult to dig deeper than 15 inches in this location.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1)(**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B)**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6(**LRR A**)
- ☐Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches): -

Water Table Present? Yes ☐ No ☒ Depth (inches): >15"

Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches): >15"

Wetland Hydrology Present? Yes ☐ No ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: We poured approximately 1 pint of water into the test pit. The water drained away in approximately 15 seconds.

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: TAL-1732 Building X Project City/County: Redmond Sampling Date: 24 Sept 2018

Applicant/Owner: OAC State: Washington Sampling Point: TP-X3

Investigator(s): DRT Section, Township, Range: SE 1/4 Section 34, T26N, R5E

Landform (hillslope, terrace, etc.): Hillslope Local relief (concave, convex, none): None Slope (%): 10%

Subregion (LRR): A Lat: 47.6908 Long: -122.1530 Datum: NAD83

Soil Map Unit Name: Alderwood gravelly sandy loam, 8-15% slopes NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☒ No ☐ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☐ No ☐ Hydric Soil Present? Yes ☐ No ☐ Wetland Hydrology Present? Yes ☐ No ☐	**Is the Sampled Area within a Wetland?** Yes ☐ No ☐

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer macrophyllum*	40	Yes	FACU
2.			
3.			
4.			
	40 = Total Cover		
Sapling/Shrub Stratum (Plot size: 15 ft)			
1. *Acer circinatum*	80	Yes	FAC
2. *Rubus spectabilis*	10		FAC
3.			
4.			
5.			
	90 = Total Cover		
Herb Stratum (Plot size: 5 ft)			
1. *Polystichum munitum*	30	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	30 = Total Cover		
Woody Vine Stratum (Plot size: 15 ft)			
1. *Rubus armeniacus*	10		FAC
2. *Rubus ursinus*	30	Yes	FACU
	= Total Cover		

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

- ☐ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ☐ **No** ☒

Remarks: Dominant species not greater than 50% FAC, FACW, or OBL.

SOIL

Sampling Point: TP-X3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-4	10YR 2/1	100					GSL	Darkened topsoil
4-8	10YR 3/4	100					VGS	Till or road aggregate.

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1 (**except MLRA 1**))
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: Gravel

Depth (inches): 8"

Hydric Soil Present? Yes ☐ No ☒

Remarks: Several attempts were made to get deeper than 8 inches. However, embedded large gravel to small cobble prevented digging any deeper.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1)(**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B)**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6(**LRR A**)
- ☐Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches): -

Water Table Present? Yes ☐ No ☒ Depth (inches): >8"

Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches): >8"

Wetland Hydrology Present? Yes ☐ No ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: TAL-1732 City/County: Redmond/King Sampling Date: 1/17/2019

Applicant/Owner: Willow Run, LLC. State: WA Sampling Point: TP-A3

Investigator(s): DRT Section, Township, Range: SE 1/4 S34, T26N, R05E, W.M.

Landform (hillslope, terrace, etc.): Hillslope Local relief (concave, convex, none): Concave Slope (%): 5

Subregion (LRR): A Lat: 47.6932 Long: -122.1538 Datum: NAD83

Soil Map Unit Name: Alderwood gravelly sandy loam, 8-15% slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☐ No ☒ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☒ No ☐ Hydric Soil Present? Yes ☒ No ☐ Wetland Hydrology Present? Yes ☒ No ☐	**Is the Sampled Area within a Wetland?** Yes ☒ No ☐

Remarks: Test plot met criteria for wetland vegetation, hydrology, and soils.

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 5m)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Alnus rubra*	10	Yes	FAC
2. *Populus balsamifera var trichocarpa*	20	Yes	FAC
3.			
4.			
	30	= Total Cover	
Sapling/Shrub Stratum (Plot size: 3m)			
1. *Rubus spectabilis*	40	Yes	FAC
2. *Rubus armeniacus*	50	Yes	FAC
3.			
4.			
5.			
	90	= Total Cover	
Herb Stratum (Plot size: 1m)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	0	= Total Cover	
Woody Vine Stratum (Plot size: 3m)			
1.			
2.			
	0	= Total Cover	

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

☒ Dominance Test is >50%

☐ Prevalence Index is ≤3.0[1]

☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ☐ **No** ☐

Remarks:

SOIL

Sampling Point: TP-A3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-9"	10YR 2/1	100	-	-	-	-	GSL	
9-25"	10YR 4/2	60	7.5YR 4/6	40	C	M	GSL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1 (**except MLRA 1**))
- ☐ Loamy Gleyed Matrix (F2)
- ☒ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? **Yes** ☒ **No** ☐

Remarks: Soil meets Hydric Soil Indicator F3.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☒ High Water Table (A2)
- ☒ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1)(**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B)**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☒ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6(**LRR A**)
- ☐Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches): _____

Water Table Present? Yes ☒ No ☐ Depth (inches): 10"

Saturation Present? (includes capillary fringe) Yes ☒ No ☐ Depth (inches): 6"

Wetland Hydrology Present? **Yes** ☒ **No** ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Positive primary hydrology indicators for A2 and A3

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: TAL-1732 City/County: Redmond/King Sampling Date: 1/17/2019

Applicant/Owner: Willow Run, LLC. State: WA Sampling Point: TP-A4

Investigator(s): DRT Section, Township, Range: SE 1/4 S34, T26N, R05E, W.M.

Landform (hillslope, terrace, etc.): _____ Local relief (concave, convex, none): _____ Slope (%): _____

Subregion (LRR): A Lat: _____ Long: _____ Datum: NAD83

Soil Map Unit Name: Alderwood gravelly sandy loam, 8-15% slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☐ No ☒ (If no, explain in Remarks.)

Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes ☒ No ☐

Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☒ No ☐ Hydric Soil Present? Yes ☐ No ☒ Wetland Hydrology Present? Yes ☐ No ☒	**Is the Sampled Area within a Wetland?** Yes ☐ No ☒

Remarks: Drier than normal conditions

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 5m)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Alnus rubra*	40	Yes	FAC
2. *Populus balsamifera var trichocarpa*	35	Yes	FAC
3.			
4.			
	75 = Total Cover		
Sapling/Shrub Stratum (Plot size: 3m)			
1. *Rubus spectabilis*	50	Yes	FAC
2. *Rubus armeniacus*	40	Yes	FAC
3.			
4.			
5.			
	90 = Total Cover		
Herb Stratum (Plot size: 1m)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	0 = Total Cover		
Woody Vine Stratum (Plot size: 3m)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum _____ % Cover of Biotic Crust _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

- ☐ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ☒ **No** ☐

Remarks:

SOIL

Sampling Point: TP-A4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0-9"	10YR 3/2	100	-	-	-	-	GSL	
9-18"	10YR 4/2	100	-	-	-	-	GSL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1 (**except MLRA 1**))
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ☐ No ☒

Remarks: No hydric soil indicators present

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1)(**LRR A**)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B)**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6(**LRR A**)
- ☐Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ☐ No ☒ Depth (inches): _____

Water Table Present? Yes ☐ No ☒ Depth (inches): >20"

Saturation Present? (includes capillary fringe) Yes ☐ No ☒ Depth (inches): >20"

Wetland Hydrology Present? Yes ☐ No ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: No wetland hydrology indicators present

Appendix C:

Wetland Rating Forms

Wetland name or number TAL-1732 Wetland A

RATING SUMMARY – Western Washington

Name of wetland (or ID #): Wetland A Date of site visit: 01-17-2019
Rated by DRT Trained by Ecology? ☒ Yes ☐ No Date of training 10-15
HGM Class used for rating Slope Wetland has multiple HGM classes? ☐ Y ☒ N

NOTE: **Form is not complete without the figures requested** *(figures can be combined)*. Source of base aerial photo/map _____

OVERALL WETLAND CATEGORY IV (based on functions ☒ or special characteristics ☐)

1. Category of wetland based on FUNCTIONS

☐ **Category I** – Total score = 23 - 27
☐ **Category II** – Total score = 20 - 22
☐ **Category III** – Total score = 16 - 19
☒ **Category IV** – Total score = 9 - 15

FUNCTION	Improving Water Quality	Hydrologic	Habitat	
		Circle the appropriate ratings		
Site Potential	L	M	L	
Landscape Potential	L	L	M	
Value	H	L	M	TOTAL
Score Based on Ratings	5	4	5	14

Score for each function based on three ratings *(order of ratings is not important)*

9 = H,H,H
8 = H,H,M
7 = H,H,L
7 = H,M,M
6 = H,M,L
6 = M,M,M
5 = H,L,L
5 = M,M,L
4 = M,L,L
3 = L,L,L

2. Category based on SPECIAL CHARACTERISTICS of wetland

CHARACTERISTIC		CATEGORY
Estuarine	☐	I II
Wetland of High Conservation Value	☐	I
Bog	☐	I
Mature Forest	☐	I
Old Growth Forest	☐	I
Coastal Lagoon	☐	I II
Interdunal	☐	I II III IV
None of the above		☐

Wetland name or number TAL-1732 Wetland A

Maps and figures required to answer questions correctly for Western Washington

Depressional Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	D 1.3, H 1.1, H 1.4	
Hydroperiods	D 1.4, H 1.2	
Location of outlet (*can be added to map of hydroperiods)*	D 1.1, D 4.1	
Boundary of area within 150 ft of the wetland *(can be added to another figure)*	D 2.2, D 5.2	
Map of the contributing basin	D 4.3, D 5.3	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	D 3.1, D 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	D 3.3	

Riverine Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	H 1.1, H 1.4	
Hydroperiods	H 1.2	
Ponded depressions	R 1.1	
Boundary of area within 150 ft of the wetland *(can be added to another figure)*	R 2.4	
Plant cover of trees, shrubs, and herbaceous plants	R 1.2, R 4.2	
Width of unit vs. width of stream *(can be added to another figure)*	R 4.1	
Map of the contributing basin	R 2.2, R 2.3, R 5.2	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	R 3.1	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	R 3.2, R 3.3	

Lake Fringe Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	L 1.1, L 4.1, H 1.1, H 1.4	
Plant cover of trees, shrubs, and herbaceous plants	L 1.2	
Boundary of area within 150 ft of the wetland *(can be added to another figure)*	L 2.2	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	L 3.1, L 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	L 3.3	

Slope Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	H 1.1, H 1.4	
Hydroperiods	H 1.2	
Plant cover of **dense** trees, shrubs, and herbaceous plants	S 1.3	
Plant cover of **dense, rigid** trees, shrubs, and herbaceous plants (*can be added to figure above)*	S 4.1	
Boundary of 150 ft buffer (can be added to another figure)	S 2.1, S 5.1	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	S 3.1, S 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	S 3.3	

Wetland name or number TAL-1732 Wetland A

HGM Classification of Wetlands in Western Washington

For questions 1-7, the criteria described must apply to the entire unit being rated.

If the hydrologic criteria listed in each question do not apply to the entire unit being rated, you probably have a unit with multiple HGM classes. In this case, identify which hydrologic criteria in questions 1-7 apply, and go to Question 8.

1. Are the water levels in the entire unit usually controlled by tides except during floods?

☒ NO – go to 2 ☐ **YES** – the wetland class is **Tidal Fringe** – go to 1.1

1.1 Is the salinity of the water during periods of annual low flow below 0.5 ppt (parts per thousand)?

☒ **NO – Saltwater Tidal Fringe (Estuarine)** ☐ **YES – Freshwater Tidal Fringe**

*If your wetland can be classified as a Freshwater Tidal Fringe use the forms for **Riverine** wetlands. If it is Saltwater Tidal Fringe it is an **Estuarine** wetland and is not scored. This method **cannot** be used to score functions for estuarine wetlands.*

2. The entire wetland unit is flat and precipitation is the only source (>90%) of water to it. Groundwater and surface water runoff are NOT sources of water to the unit.

☒ NO – go to 3 ☐ **YES** – The wetland class is **Flats**

*If your wetland can be classified as a Flats wetland, use the form for **Depressional** wetlands.*

3. Does the entire wetland unit **meet all** of the following criteria?
___The vegetated part of the wetland is on the shores of a body of permanent open water (without any plants on the surface at any time of the year) at least 20 ac (8 ha) in size; ___At least 30% of the open water area is deeper than 6.6 ft (2 m).

☒ NO – go to 4 ☐ **YES –** The wetland class is **Lake Fringe** (Lacustrine Fringe)

4. Does the entire wetland unit **meet all** of the following criteria?
☒ The wetland is on a slope (*slope can be very gradual*),
☒ The water flows through the wetland in one direction (unidirectional) and usually comes from seeps. It may flow subsurface, as sheetflow, or in a swale without distinct banks,
☒ The water leaves the wetland **without being impounded**.

☐ NO – go to 5 ☒ **YES –** The wetland class is **Slope**

NOTE: Surface water does not pond in these type of wetlands except occasionally in very small and shallow depressions or behind hummocks (depressions are usually <3 ft diameter and less than 1 ft deep).

5. Does the entire wetland unit **meet all** of the following criteria?
☐ The unit is in a valley, or stream channel, where it gets inundated by overbank flooding from that stream or river,
☐ The overbank flooding occurs at least once every 2 years.

☒ NO – go to 6 ☐ **YES** – The wetland class is **Riverine**

NOTE: The Riverine unit can contain depressions that are filled with water when the river is not flooding

Wetland name or number TAL-1732 Wetland A

6. Is the entire wetland unit in a topographic depression in which water ponds, or is saturated to the surface, at some time during the year? *This means that any outlet, if present, is higher than the interior of the wetland.*

☒ NO – go to 7 ☐ **YES** – The wetland class is **Depressional**

7. Is the entire wetland unit located in a very flat area with no obvious depression and no overbank flooding? The unit does not pond surface water more than a few inches. The unit seems to be maintained by high groundwater in the area. The wetland may be ditched, but has no obvious natural outlet.

☒ NO – go to 8 ☐ **YES** – The wetland class is **Depressional**

8. Your wetland unit seems to be difficult to classify and probably contains several different HGM classes. For example, seeps at the base of a slope may grade into a riverine floodplain, or a small stream within a Depressional wetland has a zone of flooding along its sides. GO BACK AND IDENTIFY WHICH OF THE HYDROLOGIC REGIMES DESCRIBED IN QUESTIONS 1-7 APPLY TO DIFFERENT AREAS IN THE UNIT (make a rough sketch to help you decide). Use the following table to identify the appropriate class to use for the rating system if you have several HGM classes present within the wetland unit being scored.

NOTE: Use this table only if the class that is recommended in the second column represents 10% or more of the total area of the wetland unit being rated. If the area of the HGM class listed in column 2 is less than 10% of the unit; classify the wetland using the class that represents more than 90% of the total area.

HGM classes within the wetland unit being rated	HGM class to use in rating
Slope + Riverine	Riverine
Slope + Depressional	Depressional
Slope + Lake Fringe	Lake Fringe
Depressional + Riverine along stream within boundary of depression	Depressional
Depressional + Lake Fringe	Depressional
Riverine + Lake Fringe	Riverine
Salt Water Tidal Fringe and any other class of freshwater wetland	Treat as ESTUARINE

*If you are still unable to determine which of the above criteria apply to your wetland, or if you have **more than 2 HGM classes** within a wetland boundary, classify the wetland as Depressional for the rating.*

Wetland name or number TAL-1732 Wetland A

DEPRESSIONAL AND FLATS WETLANDS

Water Quality Functions - Indicators that the site functions to improve water quality

D 1.0. Does the site have the potential to improve water quality?	
D 1.1. Characteristics of surface water outflows from the wetland: Wetland is a depression or flat depression (QUESTION 7 on key) with no surface water leaving it (no outlet). points = 3 Wetland has an intermittently flowing stream or ditch, OR highly constricted permanently flowing outlet. points = 2 Wetland has an unconstricted, or slightly constricted, surface outlet that is permanently flowing points = 1 Wetland is a flat depression (QUESTION 7 on key), whose outlet is a permanently flowing ditch. points = 1	1
D 1.2. The soil 2 in below the surface (or duff layer) is true clay or true organic *(use NRCS definitions).* Yes = 4 No = 0	0
D 1.3. Characteristics and distribution of persistent plants (Emergent, Scrub-shrub, and/or Forested Cowardin classes): Wetland has persistent, ungrazed, plants > 95% of area points = 5 Wetland has persistent, ungrazed, plants > ½ of area points = 3 Wetland has persistent, ungrazed plants > $^1/_{10}$ of area points = 1 Wetland has persistent, ungrazed plants < $^1/_{10}$ of area points = 0	0
D 1.4. Characteristics of seasonal ponding or inundation: *This is the area that is ponded for at least 2 months. See description in manual.* Area seasonally ponded is > ½ total area of wetland points = 4 Area seasonally ponded is > ¼ total area of wetland points = 2 Area seasonally ponded is < ¼ total area of wetland points = 0	0
Total for D 1 Add the points in the boxes above	

Rating of Site Potential If score is: ☐ **12-16 = H** ☐ **6-11 = M** ☐ **0-5 = L** *Record the rating on the first page*

D 2.0. Does the landscape have the potential to support the water quality function of the site?	
D 2.1. Does the wetland unit receive stormwater discharges? Yes = 1 No = 0	0
D 2.2. Is > 10% of the area within 150 ft of the wetland in land uses that generate pollutants? Yes = 1 No = 0	0
D 2.3. Are there septic systems within 250 ft of the wetland? Yes = 1 No = 0	0
D 2.4. Are there other sources of pollutants coming into the wetland that are not listed in questions D 2.1-D 2.3? Source_____ Yes = 1 No = 0	0
Total for D 2 Add the points in the boxes above	

Rating of Landscape Potential If score is: ☐ **3 or 4 = H** ☐ **1 or 2 = M** ☐ **0 = L** *Record the rating on the first page*

D 3.0. Is the water quality improvement provided by the site valuable to society?	
D 3.1. Does the wetland discharge directly (i.e., within 1 mi) to a stream, river, lake, or marine water that is on the 303(d) list? Yes = 1 No = 0	0
D 3.2. Is the wetland in a basin or sub-basin where an aquatic resource is on the 303(d) list? Yes = 1 No = 0	0
D 3.3. Has the site been identified in a watershed or local plan as important for maintaining water quality (*answer YES if there is a TMDL for the basin in which the unit is found*)? Yes = 2 No = 0	0
Total for D 3 Add the points in the boxes above	

Rating of Value If score is: ☐ **2-4 = H** ☐ **1 = M** ☐ **0 = L** *Record the rating on the first page*

Wetland name or number TAL-1732 Wetland A

DEPRESSIONAL AND FLATS WETLANDS

Hydrologic Functions - Indicators that the site functions to reduce flooding and stream degradation

D 4.0. Does the site have the potential to reduce flooding and erosion?

D 4.1. Characteristics of surface water outflows from the wetland: Wetland is a depression or flat depression with no surface water leaving it (no outlet) points = 4 Wetland has an intermittently flowing stream or ditch, OR highly constricted permanently flowing outlet points = 2 Wetland is a flat depression (QUESTION 7 on key), whose outlet is a permanently flowing ditch points = 1 Wetland has an unconstricted, or slightly constricted, surface outlet that is permanently flowing points = 0	0
D 4.2. Depth of storage during wet periods: *Estimate the height of ponding above the bottom of the outlet. For wetlands with no outlet, measure from the surface of permanent water or if dry, the deepest part.* Marks of ponding are 3 ft or more above the surface or bottom of outlet points = 7 Marks of ponding between 2 ft to < 3 ft from surface or bottom of outlet points = 5 Marks are at least 0.5 ft to < 2 ft from surface or bottom of outlet points = 3 The wetland is a "headwater" wetland points = 3 Wetland is flat but has small depressions on the surface that trap water points = 1 Marks of ponding less than 0.5 ft (6 in) points = 0	0
D 4.3. Contribution of the wetland to storage in the watershed: *Estimate the ratio of the area of upstream basin contributing surface water to the wetland to the area of the wetland unit itself.* The area of the basin is less than 10 times the area of the unit points = 5 The area of the basin is 10 to 100 times the area of the unit points = 3 The area of the basin is more than 100 times the area of the unit points = 0 Entire wetland is in the Flats class points = 5	0
Total for D 4 Add the points in the boxes above	

Rating of Site Potential If score is: ☐ **12-16 = H** ☐ **6-11 = M** ☐ **0-5 = L** *Record the rating on the first page*

D 5.0. Does the landscape have the potential to support hydrologic functions of the site?

D 5.1. Does the wetland receive stormwater discharges? Yes = 1 No = 0	0
D 5.2. Is >10% of the area within 150 ft of the wetland in land uses that generate excess runoff? Yes = 1 No = 0	0
D 5.3. Is more than 25% of the contributing basin of the wetland covered with intensive human land uses (residential at >1 residence/ac, urban, commercial, agriculture, etc.)? Yes = 1 No = 0	0
Total for D 5 Add the points in the boxes above	

Rating of Landscape Potential If score is: ☐ **3 = H** ☐ **1 or 2 = M** ☐ **0 = L** *Record the rating on the first page*

D 6.0. Are the hydrologic functions provided by the site valuable to society?

D 6.1. The unit is in a landscape that has flooding problems. *Choose the description that best matches conditions around the wetland unit being rated. Do not add points. Choose the highest score if more than one condition is met.* The wetland captures surface water that would otherwise flow down-gradient into areas where flooding has damaged human or natural resources (e.g., houses or salmon redds): • Flooding occurs in a sub-basin that is immediately down-gradient of unit. points = 2 • Surface flooding problems are in a sub-basin farther down-gradient. points = 1 Flooding from groundwater is an issue in the sub-basin. points = 1 The existing or potential outflow from the wetland is so constrained by human or natural conditions that the water stored by the wetland cannot reach areas that flood. *Explain why* points = 0 There are no problems with flooding downstream of the wetland. points = 0	0
D 6.2. Has the site been identified as important for flood storage or flood conveyance in a regional flood control plan? Yes = 2 No = 0	0
Total for D 6 Add the points in the boxes above	

Rating of Value If score is: ☐ **2-4 = H** ☐ **1 = M** ☐ **0 = L** *Record the rating on the first page*

Wetland name or number TAL-1732 Wetland A

RIVERINE AND FRESHWATER TIDAL FRINGE WETLANDS

Water Quality Functions - Indicators that the site functions to improve water quality

R 1.0. Does the site have the potential to improve water quality?	
R 1.1. Area of surface depressions within the Riverine wetland that can trap sediments during a flooding event: Depressions cover >3/4 area of wetland — points = 8 Depressions cover > ½ area of wetland — points = 4 Depressions present but cover < ½ area of wetland — points = 2 No depressions present — points = 0	0
R 1.2. Structure of plants in the wetland (areas with >90% cover at person height, **not** Cowardin classes) Trees or shrubs > 2/3 area of the wetland — points = 8 Trees or shrubs > 1/3 area of the wetland — points = 6 Herbaceous plants (> 6 in high) > 2/3 area of the wetland — points = 6 Herbaceous plants (> 6 in high) > 1/3 area of the wetland — points = 3 Trees, shrubs, and ungrazed herbaceous < 1/3 area of the wetland — points = 0	0
Total for R 1 — Add the points in the boxes above	

Rating of Site Potential If score is: ☐ **12-16 = H** ☐ **6-11 = M** ☐ **0-5 = L** *Record the rating on the first page*

R 2.0. Does the landscape have the potential to support the water quality function of the site?	
R 2.1. Is the wetland within an incorporated city or within its UGA? Yes = 2 No = 0	0
R 2.2. Does the contributing basin to the wetland include a UGA or incorporated area? Yes = 1 No = 0	0
R 2.3. Does at least 10% of the contributing basin contain tilled fields, pastures, or forests that have been clearcut within the last 5 years? Yes = 1 No = 0	0
R 2.4. Is > 10% of the area within 150 ft of the wetland in land uses that generate pollutants? Yes = 1 No = 0	0
R 2.5. Are there other sources of pollutants coming into the wetland that are not listed in questions R 2.1-R 2.4 Other sources _____ Yes = 1 No = 0	0
Total for R 2 — Add the points in the boxes above	

Rating of Landscape Potential If score is: ☐ **3-6 = H** ☐ **1 or 2 = M** ☐ **0 = L** *Record the rating on the first page*

R 3.0. Is the water quality improvement provided by the site valuable to society?	
R 3.1. Is the wetland along a stream or river that is on the 303(d) list or on a tributary that drains to one within 1 mi? Yes = 1 No = 0	0
R 3.2. Is the wetland along a stream or river that has TMDL limits for nutrients, toxics, or pathogens? Yes = 1 No = 0	0
R 3.3. Has the site been identified in a watershed or local plan as important for maintaining water quality? (*answer YES if there is a TMDL for the drainage in which the unit is found*) Yes = 2 No = 0	0
Total for R 3 — Add the points in the boxes above	

Rating of Value If score is: ☐ **2-4 = H** ☐ **1 = M** ☐ **0 = L** *Record the rating on the first page*

Wetland name or number TAL-1732 Wetland A

RIVERINE AND FRESHWATER TIDAL FRINGE WETLANDS

Hydrologic Functions - Indicators that site functions to reduce flooding and stream erosion

R 4.0. Does the site have the potential to reduce flooding and erosion?

R 4.1. Characteristics of the overbank storage the wetland provides: *Estimate the average width of the wetland perpendicular to the direction of the flow and the width of the stream or river channel (distance between banks). Calculate the ratio: (average width of wetland)/(average width of stream between banks).* If the ratio is more than 20 points = 9 If the ratio is 10-20 points = 6 If the ratio is 5-<10 points = 4 If the ratio is 1-<5 points = 2 If the ratio is < 1 points = 1	1
R 4.2. Characteristics of plants that slow down water velocities during floods: *Treat large woody debris as forest or shrub. Choose the points appropriate for the best description (polygons need to have >90% cover at person height. These are NOT Cowardin classes).* Forest or shrub for >1/3 area OR emergent plants > 2/3 area points = 7 Forest or shrub for > 1/10 area OR emergent plants > 1/3 area points = 4 Plants do not meet above criteria points = 0	0
Total for R 4 Add the points in the boxes above	

Rating of Site Potential If score is: ☐ **12-16 = H** ☐ **6-11 = M** ☐ **0-5 = L** *Record the rating on the first page*

R 5.0. Does the landscape have the potential to support the hydrologic functions of the site?

R 5.1. Is the stream or river adjacent to the wetland downcut?	Yes = 0 No = 1	0
R 5.2. Does the up-gradient watershed include a UGA or incorporated area?	Yes = 1 No = 0	0
R 5.3. Is the up-gradient stream or river controlled by dams?	Yes = 0 No = 1	0
Total for R 5	Add the points in the boxes above	

Rating of Landscape Potential If score is: ☐ **3 = H** ☐ **1 or 2 = M** ☐ **0 = L** *Record the rating on the first page*

R 6.0. Are the hydrologic functions provided by the site valuable to society?

R 6.1. Distance to the nearest areas downstream that have flooding problems? *Choose the description that best fits the site*. The sub-basin immediately down-gradient of the wetland has flooding problems that result in damage to human or natural resources (e.g., houses or salmon redds) points = 2 Surface flooding problems are in a sub-basin farther down-gradient points = 1 No flooding problems anywhere downstream points = 0	0
R 6.2. Has the site been identified as important for flood storage or flood conveyance in a regional flood control plan? Yes = 2 No = 0	0
Total for R 6 Add the points in the boxes above	

Rating of Value If score is: ☐ **2-4 = H** ☐ **1 = M** ☐ **0 = L** *Record the rating on the first page*

Wetland name or number TAL-1732 Wetland A

LAKE FRINGE WETLANDS

Water Quality Functions - Indicators that the site functions to improve water quality

L 1.0. Does the site have the potential to improve water quality?	
L 1.1. Average width of plants along the lakeshore *(use polygons of Cowardin classes)*: Plants are more than 33 ft (10 m) wide — points = 6 Plants are more than 16 ft (5 m) wide and <33 ft — points = 3 Plants are more than 6 ft (2 m) wide and <16 ft — points = 1 Plants are less than 6 ft wide — points = 0	0
L 1.2. Characteristics of the plants in the wetland: Choose the appropriate description that results in the highest points, and do not include any open water in your estimate of coverage. The herbaceous plants can be either the dominant form or as an understory in a shrub or forest community. *These are not Cowardin classes. Area of cover is total cover in the unit, but it can be in patches. Herbaceous does not include aquatic bed.* Cover of herbaceous plants is >90% of the vegetated area — points = 6 Cover of herbaceous plants is >$^2/_3$ of the vegetated area — points = 4 Cover of herbaceous plants is >$^1/_3$ of the vegetated area — points = 3 Other plants that are not aquatic bed > $^2/_3$ unit — points = 3 Other plants that are not aquatic bed in > $^1/_3$ vegetated area — points = 1 Aquatic bed plants and open water cover > $^2/_3$ of the unit — points = 0	0
Total for L 1 — Add the points in the boxes above	

Rating of Site Potential If score is: ☐ **8-12 = H** ☐ **4-7 = M** ☐ **0-3 = L** *Record the rating on the first page*

L 2.0. Does the landscape have the potential to support the water quality function of the site?	
L 2.1. Is the lake used by power boats? Yes = 1 No = 0	0
L 2.2. Is > 10% of the area within 150 ft of wetland unit on the upland side in land uses that generate pollutants? Yes = 1 No = 0	0
L 2.3. Does the lake have problems with algal blooms or excessive plant growth such as milfoil? Yes = 1 No = 0	0
Total for L 2 — Add the points in the boxes above	

Rating of Landscape Potential: If score is: ☐ **2 or 3 = H** ☐ **1 = M** ☐ **0 = L** *Record the rating on the first page*

L 3.0. Is the water quality improvement provided by the site valuable to society?	
L 3.1. Is the lake on the 303(d) list of degraded aquatic resources? Yes = 1 No = 0	0
L 3.2. Is the lake in a sub-basin where water quality is an issue (at least one aquatic resource in the basin is on the 303(d) list)? Yes = 1 No = 0	0
L 3.3. Has the site been identified in a watershed or local plan as important for maintaining water quality? *Answer YES if there is a TMDL for the lake or basin in which the unit is found.* Yes = 2 No = 0	0
Total for L 3 — Add the points in the boxes above	

Rating of Value If score is: ☐ **2-4 = H** ☐ **1 = M** ☐ **0 = L** *Record the rating on the first page*

LAKE FRINGE WETLANDS

Hydrologic Functions - Indicators that the wetland unit functions to reduce shoreline erosion

Wetland name or number TAL-1732 Wetland A

L 4.0. Does the site have the potential to reduce shoreline erosion?	
L 4.1. Distance along shore and average width of Cowardin classes along the lakeshore (**do not** include Aquatic bed): *Choose the highest scoring description that matches conditions in the wetland.* > ¾ of distance is Scrub-shrub or Forested at least 33 ft (10 m) wide — points = 6 > ¾ of distance is Scrub-shrub or Forested at least 6 ft (2 m) wide — points = 4 > ¼ distance is Scrub-shrub or Forested at least 33 ft (10 m) wide — points = 4 Plants are at least 6 ft (2 m) wide (any type except Aquatic bed) — points = 2 Plants are less than 6 ft (2 m) wide (any type except Aquatic bed) — points = 0	0

Rating of Site Potential: If score is: ☐ **6 = M** ☐ **0-5 = L** *Record the rating on the first page*

L 5.0. Does the landscape have the potential to support the hydrologic functions of the site?		
L 5.1. Is the lake used by power boats with more than 10 hp?	Yes = 1 No = 0	0
L 5.2. Is the fetch on the lake side of the unit at least 1 mile in distance?	Yes = 1 No = 0	0
Total for L 5	Add the points in the boxes above	

Rating of Landscape Potential If score is: ☐ **2 = H** ☐ **1 = M** ☐ **0 = L** *Record the rating on the first page*

L 6.0. Are the hydrologic functions provided by the site valuable to society?	
L 6.1. Are there resources along the shore that can be impacted by erosion? If more than one resource is present, choose the one with the highest score. There are human structures or old growth/mature forests within 25 ft of OHWM of the shore in the unit — points = 2 There are nature trails or other paths and recreational activities within 25 ft of OHWM — points = 1 Other resources that could be impacted by erosion — points = 1 There are no resources that can be impacted by erosion along the shores of the unit — points = 0	0

Rating of Value: If score is: ☐ **2 = H** ☐ **1 = M** ☐ **0 = L** *Record the rating on the first page*

NOTES and FIELD OBSERVATIONS:

Wetland name or number TAL-1732 Wetland A

SLOPE WETLANDS

Water Quality Functions - Indicators that the site functions to improve water quality

S 1.0. Does the site have the potential to improve water quality?	
S 1.1. Characteristics of the average slope of the wetland: *(a 1% slope has a 1 ft vertical drop in elevation for every 100 ft of horizontal distance*) Slope is 1% or less points = 3 Slope is > 1%-2% points = 2 Slope is > 2%-5% points = 1 Slope is greater than 5% points = 0	1
S 1.2. The soil 2 in below the surface (or duff layer) is true clay or true organic *(use NRCS definitions)*: Yes = 3 No = 0	0
S 1.3. Characteristics of the plants in the wetland that trap sediments and pollutants: Choose the points appropriate for the description that best fits the plants in the wetland. *Dense means you have trouble seeing the soil surface (>75% cover), and uncut means not grazed or mowed and plants are higher than 6 in.* Dense, uncut, herbaceous plants > 90% of the wetland area points = 6 Dense, uncut, herbaceous plants > ½ of area points = 3 Dense, woody, plants > ½ of area points = 2 Dense, uncut, herbaceous plants > ¼ of area points = 1 Does not meet any of the criteria above for plants points = 0	2
Total for S 1 Add the points in the boxes above	3

Rating of Site Potential If score is: ☐ **12 = H** ☐ **6-11 = M** ☒ **0-5 = L** *Record the rating on the first page*

S 2.0. Does the landscape have the potential to support the water quality function of the site?	
S 2.1. Is > 10% of the area within 150 ft on the uphill side of the wetland in land uses that generate pollutants? Yes = 1 No = 0	0
S 2.2. Are there other sources of pollutants coming into the wetland that are not listed in question S 2.1? Other sources _____ Yes = 1 No = 0	0
Total for S 2 Add the points in the boxes above	0

Rating of Landscape Potential If score is: ☐ **1-2 = M** ☒ **0 = L** *Record the rating on the first page*

S 3.0. Is the water quality improvement provided by the site valuable to society?	
S 3.1. Does the wetland discharge directly (i.e., within 1 mi) to a stream, river, lake, or marine water that is on the 303(d) list? Yes = 1 No = 0	0
S 3.2. Is the wetland in a basin or sub-basin where water quality is an issue? *At least one aquatic resource in the basin is on the 303(d) list*. Yes = 1 No = 0	1
S 3.3. Has the site been identified in a watershed or local plan as important for maintaining water quality? *Answer YES if there is a TMDL for the basin in which unit is found.* Yes = 2 No = 0	2
Total for S 3 Add the points in the boxes above	3

Rating of Value If score is: ☒ **2-4 = H** ☐ **1 = M** ☐ **0 = L** *Record the rating on the first page*

Wetland name or number TAL-1732 Wetland A

SLOPE WETLANDS

Hydrologic Functions - Indicators that the site functions to reduce flooding and stream erosion

S 4.0. Does the site have the potential to reduce flooding and stream erosion?	
S 4.1. Characteristics of plants that reduce the velocity of surface flows during storms: Choose the points appropriate for the description that best fits conditions in the wetland. *Stems of plants should be thick enough (usually > 1/8 in), or dense enough, to remain erect during surface flows.* Dense, uncut, **rigid** plants cover > 90% of the area of the wetland points = 1 All other conditions points = 0	1

Rating of Site Potential If score is: ☒ **1 = M** ☐ **0 = L** *Record the rating on the first page*

S 5.0. Does the landscape have the potential to support the hydrologic functions of the site?	
S 5.1. Is more than 25% of the area within 150 ft upslope of wetland in land uses or cover that generate excess surface runoff? Yes = 1 No = 0	0

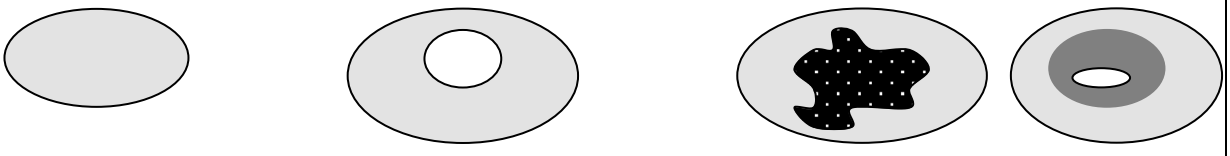
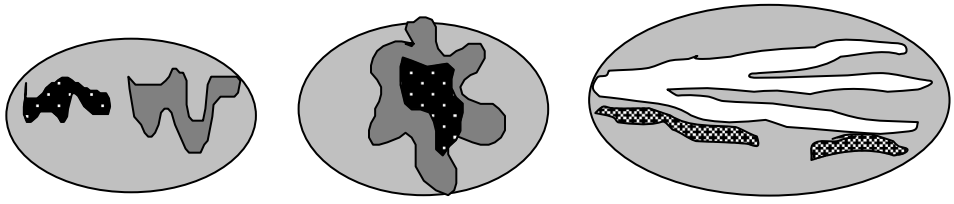
Rating of Landscape Potential If score is: ☐ **1 = M** ☒ **0 = L** *Record the rating on the first page*

S 6.0. Are the hydrologic functions provided by the site valuable to society?	
S 6.1. Distance to the nearest areas downstream that have flooding problems: The sub-basin immediately down-gradient of site has flooding problems that result in damage to human or natural resources (e.g., houses or salmon redds) points = 2 Surface flooding problems are in a sub-basin farther down-gradient points = 1 No flooding problems anywhere downstream points = 0	0
S 6.2. Has the site been identified as important for flood storage or flood conveyance in a regional flood control plan? Yes = 2 No = 0	0
Total for S 6 Add the points in the boxes above	0

Rating of Value If score is: ☐ **2-4 = H** ☐ **1 = M** ☒ **0 = L** *Record the rating on the first page*

NOTES and FIELD OBSERVATIONS:

Flooding on the Sammamish River no longer occurs. Water levels controlled by the Ballard Locks.

These questions apply to wetlands of all HGM classes. HABITAT FUNCTIONS - Indicators that site functions to provide important habitat	
H 1.0. Does the site have the potential to provide habitat?	
H 1.1. Structure of plant community: *Indicators are Cowardin classes and strata within the Forested class.* Check the Cowardin plant classes in the wetland. *Up to 10 patches may be combined for each class to meet the threshold of ¼ ac or more than 10% of the unit if it is smaller than 2.5 ac. Add the number of structures checked.* ☐ Aquatic bed — 4 structures or more: points = 4 ☐ Emergent — 3 structures: points = 2 ☒ Scrub-shrub (areas where shrubs have > 30% cover) — 2 structures: points = 1 ☐ Forested (areas where trees have > 30% cover) — 1 structure: points = 0 *If the unit has a Forested class, check if:* ☐ The Forested class has 3 out of 5 strata (canopy, sub-canopy, shrubs, herbaceous, moss/ground-cover) that each cover 20% within the Forested polygon	0
H 1.2. Hydroperiods Check the types of water regimes (hydroperiods) present within the wetland. The water regime has to cover more than 10% of the wetland or ¼ ac to count (*see text for descriptions of hydroperiods*). ☐ Permanently flooded or inundated — 4 or more types present: points = 3 ☐ Seasonally flooded or inundated — 3 types present: points = 2 ☒ Occasionally flooded or inundated — 2 types present: points = 1 ☒ Saturated only — 1 type present: points = 0 ☐ Permanently flowing stream or river in, or adjacent to, the wetland ☐ Seasonally flowing stream in, or adjacent to, the wetland ☐ **Lake Fringe wetland** — **2 points** ☐ **Freshwater tidal wetland** — **2 points**	1
H 1.3. Richness of plant species Count the number of plant species in the wetland that cover at least 10 ft^2. *Different patches of the same species can be combined to meet the size threshold and you do not have to name the species.* ***Do not include Eurasian milfoil, reed canarygrass, purple loosestrife, Canadian thistle*** If you counted: > 19 species — points = 2 5 - 19 species — points = 1 < 5 species — points = 0	0
H 1.4. Interspersion of habitats Decide from the diagrams below whether interspersion among Cowardin plants classes (described in H 1.1), or the classes and unvegetated areas (can include open water or mudflats) is high, moderate, low, or none. *If you have four or more plant classes or three classes and open water, the rating is always high.*  **None** = 0 points **Low** = 1 point **Moderate** = 2 points All three diagrams in this row are **HIGH** = 3points 	0

Wetland name or number TAL-1732 Wetland A

H 1.5. Special habitat features: Check the habitat features that are present in the wetland. *The number of checks is the number of points.* ☐ Large, downed, woody debris within the wetland (> 4 in diameter and 6 ft long). ☒ Standing snags (dbh > 4 in) within the wetland ☐ Undercut banks are present for at least 6.6 ft (2 m) **and/or** overhanging plants extends at least 3.3 ft (1 m) over a stream (or ditch) in, or contiguous with the wetland, for at least 33 ft (10 m) ☐ Stable steep banks of fine material that might be used by beaver or muskrat for denning (> 30 degree slope) OR signs of recent beaver activity are present *(cut shrubs or trees that have not yet weathered where wood is exposed)* ☐ At least ¼ ac of thin-stemmed persistent plants or woody branches are present in areas that are permanently or seasonally inundated *(structures for egg-laying by amphibians)* ☐ Invasive plants cover less than 25% of the wetland area in every stratum of plants (*see H 1.1 for list of strata*)	1
Total for H 1 Add the points in the boxes above	2

Rating of Site Potential If score is: ☐ **15-18 = H** ☐ **7-14 = M** ☒ **0-6 = L** *Record the rating on the first page*

H 2.0. Does the landscape have the potential to support the habitat functions of the site?

H 2.1. Accessible habitat (include *only habitat that directly abuts wetland unit*). *Calculate:* % undisturbed habitat 22 **+** [(% moderate and low intensity land uses)/2] 0.06 **=** 22.06% If total accessible habitat is: > 1/3 (33.3%) of 1 km Polygon points = 3 20-33% of 1 km Polygon points = 2 10-19% of 1 km Polygon points = 1 < 10% of 1 km Polygon points = 0	2
H 2.2. Undisturbed habitat in 1 km Polygon around the wetland. *Calculate:* % undisturbed habitat 22 **+** [(% moderate and low intensity land uses)/2] 0.06 **=** 22.06% Undisturbed habitat > 50% of Polygon points = 3 Undisturbed habitat 10-50% and in 1-3 patches points = 2 Undisturbed habitat 10-50% and > 3 patches points = 1 Undisturbed habitat < 10% of 1 km Polygon points = 0	2
H 2.3. Land use intensity in 1 km Polygon: If > 50% of 1 km Polygon is high intensity land use points = (- 2) ≤ 50% of 1 km Polygon is high intensity points = 0	-2
Total for H 2 Add the points in the boxes above	2

Rating of Landscape Potential If score is: ☐ **4-6 = H** ☒ **1-3 = M** ☐ **< 1 = L** *Record the rating on the first page*

H 3.0. Is the habitat provided by the site valuable to society?

H 3.1. Does the site provide habitat for species valued in laws, regulations, or policies? *Choose only the highest score that applies to the wetland being rated.* Site meets ANY of the following criteria: points = 2 ☐ It has 3 or more priority habitats within 100 m (see next page) ☐ It provides habitat for Threatened or Endangered species (any plant or animal on the state or federal lists) ☐ It is mapped as a location for an individual WDFW priority species ☐ It is a Wetland of High Conservation Value as determined by the Department of Natural Resources ☐ It has been categorized as an important habitat site in a local or regional comprehensive plan, in a Shoreline Master Plan, or in a watershed plan Site has 1 or 2 priority habitats (listed on next page) within 100 m points = 1 Site does not meet any of the criteria above points = 0	1

Rating of Value If score is: ☐ **2 = H** ☒ **1 = M** ☐ **0 = L** *Record the rating on the first page*

Wetland name or number TAL-1732 Wetland A

WDFW Priority Habitats

Priority habitats listed by WDFW (see complete descriptions of WDFW priority habitats, and the counties in which they can be found, in: Washington Department of Fish and Wildlife. 2008. Priority Habitat and Species List. Olympia, Washington. 177 pp. http://wdfw.wa.gov/publications/00165/wdfw00165.pdf or access the list from here: http://wdfw.wa.gov/conservation/phs/list/)

Count how many of the following priority habitats are within 330 ft (100 m) of the wetland unit: ***NOTE:*** *This question is independent of the land use between the wetland unit and the priority habitat.*

☐ **Aspen Stands:** Pure or mixed stands of aspen greater than 1 ac (0.4 ha).

☐ **Biodiversity Areas and Corridors**: Areas of habitat that are relatively important to various species of native fish and wildlife (*full descriptions in WDFW PHS report*).

☐ **Herbaceous Balds:** Variable size patches of grass and forbs on shallow soils over bedrock.

☐ **Old-growth/Mature forests:** Old-growth west of Cascade crest – Stands of at least 2 tree species, forming a multilayered canopy with occasional small openings; with at least 8 trees/ac (20 trees/ha) > 32 in (81 cm) dbh or > 200 years of age. Mature forests – Stands with average diameters exceeding 21 in (53 cm) dbh; crown cover may be less than 100%; decay, decadence, numbers of snags, and quantity of large downed material is generally less than that found in old-growth; 80-200 years old west of the Cascade crest.

☐ **Oregon White Oak:** Woodland stands of pure oak or oak/conifer associations where canopy coverage of the oak component is important (*full descriptions in WDFW PHS report p. 158 – see web link above*).

☒ **Riparian**: The area adjacent to aquatic systems with flowing water that contains elements of both aquatic and terrestrial ecosystems which mutually influence each other.

☐ **Westside Prairies:** Herbaceous, non-forested plant communities that can either take the form of a dry prairie or a wet prairie (*full descriptions in WDFW PHS report p. 161 – see web link above*).

☐ **Instream:** The combination of physical, biological, and chemical processes and conditions that interact to provide functional life history requirements for instream fish and wildlife resources.

☐ **Nearshore**: Relatively undisturbed nearshore habitats. These include Coastal Nearshore, Open Coast Nearshore, and Puget Sound Nearshore. (*full descriptions of habitats and the definition of relatively undisturbed are in WDFW report – see web link on previous page).*

☐ **Caves:** A naturally occurring cavity, recess, void, or system of interconnected passages under the earth in soils, rock, ice, or other geological formations and is large enough to contain a human.

☐ **Cliffs:** Greater than 25 ft (7.6 m) high and occurring below 5000 ft elevation.

☐ **Talus:** Homogenous areas of rock rubble ranging in average size 0.5 - 6.5 ft (0.15 - 2.0 m), composed of basalt, andesite, and/or sedimentary rock, including riprap slides and mine tailings. May be associated with cliffs.

☒ **Snags and Logs:** Trees are considered snags if they are dead or dying and exhibit sufficient decay characteristics to enable cavity excavation/use by wildlife. Priority snags have a diameter at breast height of > 20 in (51 cm) in western Washington and are > 6.5 ft (2 m) in height. Priority logs are > 12 in (30 cm) in diameter at the largest end, and > 20 ft (6 m) long.

Note: All vegetated wetlands are by definition a priority habitat but are not included in this list because they are addressed elsewhere.

Wetland name or number TAL-1732 Wetland A

CATEGORIZATION BASED ON SPECIAL CHARACTERISTICS

Wetland Type *Check off any criteria that apply to the wetland. Circle the category when the appropriate criteria are met.*	**Category**
SC 1.0. Estuarine wetlands Does the wetland meet the following criteria for Estuarine wetlands? ☐ The dominant water regime is tidal, ☐ Vegetated, and ☐ With a salinity greater than 0.5 ppt ☐ Yes –Go to **SC 1.1** ☒ No= **Not an estuarine wetland**	
SC 1.1. Is the wetland within a National Wildlife Refuge, National Park, National Estuary Reserve, Natural Area Preserve, State Park or Educational, Environmental, or Scientific Reserve designated under WAC 332-30-151? ☐ Yes = **Category I** ☐ No - Go to **SC 1.2**	No
SC 1.2. Is the wetland unit at least 1 ac in size and meets at least two of the following three conditions? ☐ The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing, and has less than 10% cover of non-native plant species. (If non-native species are *Spartina*, see page 25) ☐ At least ¾ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or unmowed grassland. ☐ The wetland has at least two of the following features: tidal channels, depressions with open water, or contiguous freshwater wetlands. Yes = **Category I** No = **Category II**	No
SC 2.0. Wetlands of High Conservation Value (WHCV) SC 2.1. Has the WA Department of Natural Resources updated their website to include the list of Wetlands of High Conservation Value? ☐ Yes – Go to **SC 2.2** ☐ No – Go to **SC 2.3** SC 2.2. Is the wetland listed on the WDNR database as a Wetland of High Conservation Value? ☐ Yes **= Category I** ☒ No **= Not a WHCV** SC 2.3. Is the wetland in a Section/Township/Range that contains a Natural Heritage wetland? http://www1.dnr.wa.gov/nhp/refdesk/datasearch/wnhpwetlands.pdf ☐ Yes **– Contact WNHP/WDNR and go to SC 2.4** ☒ No **= Not a WHCV** SC 2.4. Has WDNR identified the wetland within the S/T/R as a Wetland of High Conservation Value and listed it on their website? ☐ Yes **= Category I** ☒ No **= Not a WHCV**	No
SC 3.0. Bogs Does the wetland (or any part of the unit) meet both the criteria for soils and vegetation in bogs? *Use the key below.* ***If you answer YES you will still need to rate the wetland based on its functions.*** SC 3.1. Does an area within the wetland unit have organic soil horizons, either peats or mucks, that compose 16 in or more of the first 32 in of the soil profile? ☐ Yes – Go to **SC 3.3** ☐ No – Go to **SC 3.2** SC 3.2. Does an area within the wetland unit have organic soils, either peats or mucks, that are less than 16 in deep over bedrock, or an impermeable hardpan such as clay or volcanic ash, or that are floating on top of a lake or pond? ☐ Yes – Go to **SC 3.3** ☐ No = **Is not a bog** SC 3.3. Does an area with peats or mucks have more than 70% cover of mosses at ground level, AND at least a 30% cover of plant species listed in Table 4? ☐ Yes = **Is a Category I bog** ☐ No – Go to **SC 3.4** **NOTE:** If you are uncertain about the extent of mosses in the understory, you may substitute that criterion by measuring the pH of the water that seeps into a hole dug at least 16 in deep. If the pH is less than 5.0 and the plant species in Table 4 are present, the wetland is a bog. SC 3.4. Is an area with peats or mucks forested (> 30% cover) with Sitka spruce, subalpine fir, western red cedar, western hemlock, lodgepole pine, quaking aspen, Engelmann spruce, or western white pine, AND any of the species (or combination of species) listed in Table 4 provide more than 30% of the cover under the canopy? ☐ Yes = **Is a Category I bog** ☒ No **= Is not a bog**	No

SC 4.0. Forested Wetlands Does the wetland have at least 1 contiguous acre of forest that meets one of these criteria for the WA Department of Fish and Wildlife's forests as priority habitats? ***If you answer YES you will still need to rate the wetland based on its functions.*** ☐ **Old-growth forests** (west of Cascade crest): Stands of at least two tree species, forming a multi-layered canopy with occasional small openings; with at least 8 trees/ac (20 trees/ha) that are at least 200 years of age OR have a diameter at breast height (dbh) of 32 in (81 cm) or more. ☐ **Mature forests** (west of the Cascade Crest): Stands where the largest trees are 80- 200 years old OR the species that make up the canopy have an average diameter (dbh) exceeding 21 in (53 cm). ☐ Yes **= Category I** ☒ No **= Not a forested wetland for this section**	No
SC 5.0. Wetlands in Coastal Lagoons Does the wetland meet all of the following criteria of a wetland in a coastal lagoon? ☐ The wetland lies in a depression adjacent to marine waters that is wholly or partially separated from marine waters by sandbanks, gravel banks, shingle, or, less frequently, rocks ☐ The lagoon in which the wetland is located contains ponded water that is saline or brackish (> 0.5 ppt) during most of the year in at least a portion of the lagoon *(needs to be measured near the bottom)* ☐ Yes – Go to **SC 5.1** ☒ No = **Not a wetland in a coastal lagoon** SC 5.1. Does the wetland meet all of the following three conditions? ☐ The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing), and has less than 20% cover of aggressive, opportunistic plant species (see list of species on p. 100). ☐ At least ¾ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or unmowed grassland. ☐ The wetland is larger than $^1/_{10}$ ac (4350 ft^2) ☐ Yes = **Category I** ☐ No = **Category II**	No
SC 6.0. Interdunal Wetlands Is the wetland west of the 1889 line (also called the Western Boundary of Upland Ownership or WBUO)? ***If you answer yes you will still need to rate the wetland based on its habitat functions.*** In practical terms that means the following geographic areas: ☐ Long Beach Peninsula: Lands west of SR 103 ☐ Grayland-Westport: Lands west of SR 105 ☐ Ocean Shores-Copalis: Lands west of SR 115 and SR 109 ☐ Yes – Go to **SC 6.1** ☒ No = **not an interdunal wetland for rating** SC 6.1. Is the wetland 1 ac or larger and scores an 8 or 9 for the habitat functions on the form (rates H,H,H or H,H,M for the three aspects of function)? ☐ Yes = **Category I** ☐ No – Go to **SC 6.2** SC 6.2. Is the wetland 1 ac or larger, or is it in a mosaic of wetlands that is 1 ac or larger? ☐ Yes = **Category II** ☐ No – Go to **SC 6.3** SC 6.3. Is the unit between 0.1 and 1 ac, or is it in a mosaic of wetlands that is between 0.1 and 1 ac? ☐ Yes = **Category III** ☐ No = **Category IV**	No
Category of wetland based on Special Characteristics If you answered No for all types, enter "Not Applicable" on Summary Form	N/A

Appendix D:

Hydrologic and Hydraulic Analysis of Large Woody Material Stability

GeoEngineers, 17 October 2019

Hydrologic and Hydraulic Analysis of Large Woody Material

Building X
Redmond, Washington

For

Willow Run, LLC

October 17, 2019

GeoEngineers
Earth Science + Technology

Hydrologic and Hydraulic Analysis of Large Woody Material Stability

Building X
Redmond, Washington

for

Willow Run, LLC

October 17, 2019

GeoEngineers

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Hydrologic and Hydraulic Analysis of Large Woody Material Stability

Building X
Redmond, Washington

File No. 23237-002-01

October 17, 2019

Prepared for:

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1.0 INTRODUCTION

Willow Run, LLC is currently in design for redevelopment of the project site. As part of the redevelopment, Building X, an unnamed stream flows through the north portion of the project site. The stream is being realigned to avoid impacts with the development and flows through three created wetland cells. Large woody material (LWM) is proposed in the stream channel and wetland cells. City of Redmond reviewers requested LWM stability calculations during the permit review process. The stream, wetland and LWM layout were developed by Talasaea Consultants, Inc. (Talasaea [environmental consultant]) and Coughlin Porter Lundeen (civil engineer).

This report presents our results of the LWM stability analyses conducted for Willow Run, LLC by GeoEngineers, Inc. (GeoEngineers) for the Building X project located at 10301 Willows Road NE in Redmond, Washington. The site is shown relative to the surrounding physical features in Figure 1, Vicinity Map.

2.0 SCOPE OF SERVICES

GeoEngineers performed hydrologic and hydraulic analyses as well as stability calculations for the LWM proposed by Talasaea and Coughlin Porter Lundeen (CPL) to be placed within the proposed wetland and channel as were requested by the City of Redmond during the project permitting process. Only the proposed conditions were modeled for this hydraulic analysis.

1. We evaluated LWM risk to identify design criteria using the methods of the Bureau of Reclamation's 2014 "Pacific Northwest Region Resource & Technical Services: Large Woody Material—Risk Based Design Guidelines" (BOR 2014).
2. We performed a hydrologic analysis, based on basin boundaries provided by CPL, to estimate the peak flow for the recurrence interval identified in task 1.
3. We conducted a hydraulic analysis of the proposed channel using the peak flow determined in task 2.
4. We conducted the LWM stability analysis using the hydraulic results from task 3.
5. We sketched a typical section for the LWM structure which needed anchoring and/or ballast for stability.
6. This LWM Stability Evaluation report presents our results from subtasks 1 through 5.
7. We engaged in design coordination with Talasaea and CPL via teleconference.
8. Response to one round of additional permitting questions regarding the LWM is anticipated following this draft report.

This report fulfills the requirements of tasks 1 through 6.

2.1. Assumptions

- CPL has delineated the contributing basin areas and basin boundaries and provided in DWG or SHP format.

- Talasaea's proposed channel grading plan was provided in DWG format with Civil3D objects (Figure 2, LMW Plan View):
- Proposed channel alignment
- Proposed surface
- Existing surface
- Talasaea provided the gradation of the proposed streambed material.
- We evaluated three LWM structure types as shown on Talasaea's proposed channel grading plan.
- We will provide two submittals of letter report and attachments digitally as portable document format (PDF) (draft and final).
- CPL or Talasaea will incorporate the structures as provided in the typical detail sketches into the grading plan.
- GeoEngineers will not stamp, sign or be responsible for the grading plan.
- LWM construction will be completed in compliance with the assumptions and recommendations for stability, including but not limited to wood species, size, embedment and anchoring.

2.2. Exclusions

- Channel stability analysis and freeboard evaluation
- Modifications to the proposed channel grading plan
- In-person meetings and travel
- Evaluation of hydraulic structures including but not limited to manholes, culverts, inlets

3.0 LARGE WOODY MATERIAL RISK ANALYSIS

GeoEngineers completed a LWM risk analysis using a *Large Woody Material Risk Assessment Workbook* based on the Bureau of Reclamation's methods (BOR 2014; Appendix A). The workbook recommends a design flow rate and factors of safety (FOS) for structural stability based on evaluations of public safety and property damage risk matrices. The FOS is calculated as the ratio of forces resisting movement to the forces driving movement.

3.1. Public Safety Risk

The public safety risk matrix focuses on the risk characteristics of the LWM structure and the public usage of the project site (reach-use). Different LWM structure characteristics, such as the position and location of LWM, hydrologic and hydraulic conditions of the proposed stream and channel, as well as the type of LWM structure were all ranked on a scale of from 1 to 10 (10 having the highest risk). The average score of these factors are then plotted against the average reach-use characteristics, which focuses on the access and usage of the waterway by the public. Public safety risk was scored as "low" because no recreational use will occur within the proposed wetland and channel (Appendix A).

3.2. Property and Project Risk

Property and project risks are evaluated against stream response potential to determine the overall risk of property damage. The property and project characteristics consider the amount, type, and vulnerability of the in-channel and floodplain LWM, as well as the surrounding land use and built environment. Stream response potential considers factors such as bank erosion potential and bed scour, hydrologic conditions and the riparian corridor attributes. Due to the urban nature of the proposed site, rainfall driven hydrologic conditions, and steep proposed channel grading, the property damage risk received a score of "moderate" (Appendix A).

3.3. Minimum Recommendations

The low public safety risk and moderate property damage risk findings, described above, result in minimum design criteria including design recurrence flow, factors of safety and hydraulic modeling methods for the LWM stability analysis (Appendix A). Table 1 presents the minimum design discharge recurrence interval and factors of safety used in the hydraulic and LWM stability analyses (BOR 2014).

TABLE 1. LARGE WOODY MATERIAL DESIGN CRITERIA

Design Criterion	Minimum Value
Flow Recurrence Interval	25 years
$FOS_{Sliding}$	1.5
$FOS_{Buoyancy}$	1.75
$FOS_{Rotation}$ / $FOS_{Overturning}$	1.5

4.0 HYDROLOGIC ANALYSIS

The project area is located in King County, Washington within the City of Redmond. The unnamed creek is within an ungaged basin and no long-term surface water monitoring data is available. The Western Washington Hydrology Model (WWHM) was used to model the runoff generated within the basin using continuous simulation of precipitation data from October 1948 to October 2012. The WWHM gage used is located at SeaTac and the precipitation factor was 1.0.

The drainage basin contributing the unnamed stream is 8.99 acres (Table 2). The basin was divided into the North Upstream subbasin, delineated by CPL, and the on-site subbasin delineated using AutoCAD by GeoEngineers with surfaces provided by CPL (Table 2). The United States Department of Agriculture (USDA) Web Soil Survey (WSS) application provided basin hydrologic soil group and slope information for the basin (Appendix B). The land use cover was determined using the City of Redmond zoning map (City of Redmond 2019). Landcover, slope and hydrologic soil group rating were characterized for each subbasin as input to WWHM as one basin routed to one point of compliance (Appendix C). The results of the predeveloped scenario were analyzed within WWHM to estimate the 2-year through 100-year peak flows (Table 3).

TABLE 2. SUBBASIN CHARACTERIZATION

Subbasin	Area (ac)	Pervious Area (ac)	Impervious Area (ac)
North (off-site)	8.65	4.46	4.19
On-site	0.34	0.34	0.00
Total	**8.99**	**4.80**	**4.19**

TABLE 3. PEAK FLOWS

Recurrence Interval (Year)	Flow Rate (feet^3/second)
2	2.0
10	2.6
25	3.6
50	4.0
100	4.5

5.0 HYDRAULIC ANALYSIS

Hydraulic analysis of the proposed conditions utilized the United States Army Corps of Engineers' (USACE) Hydrologic Engineering Center's River Analysis System (HEC-RAS) version 5.0.7. A 2-Dimensional (2D) model was developed to evaluate the water surface elevation, velocities, and depths throughout the proposed site. Figure 3, HEC-RAS Schematic shows the model schematic and results are presented in Appendix D.

Proposed conditions were evaluated using the design information provided by CPL and Talasaea regarding LWM dimensions, LWM layout, soil properties, site grading, wetland functionality, and revegetation.

5.1. Input Data

The proposed terrain is composed of two AutoDesk Civil 3D surfaces provided by CPL representing existing and proposed conditions. A combined surface was created by merging the two surfaces in AutoCAD for export to HEC-RAS as the model's terrain (Figure 3). HEC-RAS 2D creates a flow area with a delineated project boundary and mesh size. Additional information was incorporated into the flow area by drawing break lines, which represent substantial barriers to flow and orient individual cells perpendicular to the direction of flow. Individual cells were defined with dimensions of 5 feet by 5 feet for the majority of the 2D flow area. Cell density was increased surrounding each break line by decreasing the cell size to 3 feet by 3 feet.

Roughness coefficients (Manning's n) values were selected to represent the roughness or fiction applied to flow by the channel, vegetation, obstructions, etc., throughout the 2D mesh (Figure 3). The wetland cells and floodplain were given the same value since the proposed wetlands will be revegetated following construction (Table 4). The proposed channel and LWM locations were defined with their own roughness coefficient values (Table 4). Roughness values were determined using V.T. Chow's *Open Channel Hydraulics* and engineering judgement (Chow 1959).

TABLE 4. ROUGHNESS COEFFICIENT VALUES

Land Cover	Roughness Coefficient (*n*)
Channel	0.04
Wetland	0.07
Floodplain	0.07
LWM	0.20

Boundary conditions were applied at the upstream and downstream ends of the model domain (Figure 3). An 8-hour steady flow hydrograph was applied at the upstream extent of the 2D mesh. A constant flow of 3.6 cubic feet per second (cfs) (from the hydrologic modeling, the 25-year design event) was input as the hydrograph. A normal depth boundary condition was applied at the downstream end of the model domain (Figure 3). A friction slope of 0.05 was input within the boundary condition to match the downstream pipe network. The model was run for 8 hours with a computational interval of one second to reach steady state conditions for LWM stability analysis.

5.2. Results

The HEC-RAS model's internal geospatial mapping program, RAS Mapper, graphically displays the simulation results along the geospatial terrain of the 2D model. Section lines were cut at the location of the representative LWM structures to extract hydraulic data for stability analysis including water depth, water surface elevation, and velocity (Table 5; Appendix D).

TABLE 5. SUMMARY OF WATER DEPTHS AND VELOCITIES AT LWM STRUCTURES (3.6 CFS)

LWM ID	Station	Type	Water Depth (feet)	Velocity (feet/second)
LWM Type A (1)	1+23	Rootwad	0.3	3.7
LWM Type A (2)	1+09	Rootwad	0.3	3.3
LWM Type B (1)	0+04	Deflector	0.5	2.1
LWM Type B (2)	0+68	Deflector	1.2	1.7
LWM Type C (1)	0+40	Log Weir	0.6	2.2
LWM Type C (2)	0+83	Log Weir	0.4	1.9

6.0 LARGE WOODY MATERIAL STABILITY ANALYSIS

GeoEngineers used the USDA Forest Service's Computational Design Tool for Evaluating the Stability of Large Wood Structures workbook to evaluate stability of the proposed LWM structures (Rafferty, 2016; Appendix E).

6.1. Methods

Talasaea provided a design basemap in DWG format with three types of LWM structures: rootwad logs within the proposed channel (LWM Type A); deflector logs within the wetlands (LWM Type B); and log weirs at the wetland outlets (LWM Type C). The log lengths varied from 8 to 12 feet and all logs were 12 inches diameter at breast height (Table 6). Logs are also assumed to be Western Red Cedar and free of cracks,

decay, or other structural deficiencies. LWM stability was evaluated at two locations for each structure type (Table 5).

Based on plans provided to us by Talasaea, all structures are assumed to be laid on top of the finished surface without embedment in the channel bank or bed except the log weir structures. The log weirs were assumed to be partially embedded within both banks of the channel (Appendix E). The streambank and floodplain material is assumed to be composed of silty sand with gravel represented as "fine sand, dense" within the USDA Forest Service's workbook (Appendix E). A D_{50} for the proposed streambed gravel was assumed to 25.4 millimeter (mm) based on the material specifications provided by Talasaea.

TABLE 6. LOG SIZES AND DIMENSIONS

Log Type	Structure Type	Length (feet)	Diameter (inch)	Root Mass (inch)
Deflector	A	12	12	N/A
Rootwad	B	8	10	36
Key log/ log weir	C	12	12	N/A

6.2. Analysis Results

The balance of vertical, horizontal, and rotational forces were calculated for each LWM structure type and representative location (Table 7). Based on our analysis and assumptions outlined above, LWM Types A and B are stable without additional anchoring and the factors of safety exceed the minimum design criteria determined by the risk analysis (Table 1).

Preliminary analysis of both LWM Type C structures produced unstable results. Two main components to the LWM Type C structures, rootwad and key/weir logs, were analyzed separately. The rootwads were unstable vertically and the key/weir logs were vertically and rotationally unstable (Table 7). However, the resultant rotational FOSs from the moment force balance calculations are less than the minimum recommended criteria due to limitations in the analysis technique, which does not account for the resistance of the log weir being embedded into the bank on both sides. The log weirs are unlikely to move rotationally if embedded into the banks as shown on Talasaea's grading plan (Figure 2).

TABLE 7. SUMMARY OF LWM STRUCTURE STABILITY

LWM ID	Station	FOS[1], Vertical	FOS[2], Horizontal	FOS[3], Rotational
LWM Type A (1)	1+23	4.33	525.1	20.6
LWM Type A (2)	1+09	5.62	9.5	23.8
LWM Type B (1) (entire structure)	0+04	1.82	57.1	3.5
LWM Type B (2) (entire structure)	0+68	2.34	1,080.3	4.9
LWM Type C (1) – Key /Weir Log	0+40	0.65	2.2	0.99
LWM Type C (2) – Key / Weir Log	0+83	0.58	6.1	0.97

Notes:

[1] Vertical factor of safety is calculated as the ratio of resistant forces (bed friction, passive soil resistance) over driving forces (drag, rotational moment). See Appendix E for details.

[2] Horizontal factor of safety is calculated as the ratio of resistant forces (weight of log, ballast) over driving forces (buoyancy, lift force). See Appendix E for details.

[3] Rotational factor of safety is calculated as the ratio of resistant forces (friction, passive soil resistance, bed friction) over driving forces (rotational moment).

7.0 RECOMMENDATIONS FOR LWM STABILITY

The LWM Type C structures are not stable as originally designed. Structure stability can be achieved by increasing the burial depth of the end of each rootwad to at least 3 feet and rotating the log 0 to 15 degrees off the key/weir log (Figure 4, LWM Type C Design Recommendations). Additional ballast is required to achieve stability for the key/weir log component of LWM Type C. The height of the channel banks is too low to provide sufficient soil ballast for stability. A total weight of 700 pounds (minimum) of rock ballast on top of the key/weir log meets the minimum vertical factor of safety. Half of that total shall be positioned 1 foot from either end of the log (Figure 4). Additional rock may be required in order to balance the required weight on top of the log. Rocks shall have a minimum diameter of 8 inches and be well-rounded river rock with a length-to-width ratio of less than three. Table 8 presents the factors of safety for the vertical, horizontal, and rotational forces with the recommended design changes.

TABLE 8. LWM TYPE C RECOMMENDATIONS

LWM Type C Component	Minimum Total Rock Ballast (lbs)	Log Rotation	Minimum Embedment Depth (ft)	Minimum Embedment Length (ft)	FOS[1], Vertical	FOS[2], Horizontal	FOS[3], Rotational
LWM Type C (1) – US Rootwad	-	0° - 15°	3	5	1.7	4.4	2.2
LWM Type C (1) - Key / Weir Log	700	0	0.5	3 (at each end)	1.8	4.6	3.1

LWM Type C Component	Minimum Total Rock Ballast (lbs)	Log Rotation	Minimum Embedment Depth (ft)	Minimum Embedment Length (ft)	FOS[1], Vertical	FOS[2], Horizontal	FOS[3], Rotational
LWM Type C (2) – US Rootwad	-	0° - 15°	3	5	1.9	28.9	4.7
LWM Type C (2) - Key / Weir Log	700	0	0.2	3 (at each end)	1.8	10.5	3.4

Notes:

[1] Vertical factor of safety is calculated as the ratio of resistant forces (bed friction, passive soil resistance) over driving forces (drag, rotational moment). See Appendix E for details.

[2] Horizontal factor of safety is calculated as the ratio of resistant forces (weight of log, ballast) over driving forces (buoyancy, lift force). See Appendix E for details.

[3] Rotational factor of safety is calculated as the ratio of resistant forces (friction, passive soil resistance, bed friction) over driving forces (rotational moment).

8.0 LIMITATIONS

We have prepared this report for Willow Run, LLC for the Building X Large Woody Material Stability project. Willow Run, LLC may distribute copies of this report to its authorized agents and regulatory agencies as may be required for the project.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of stream and river habitat enhancement, stabilization and restoration design engineering in this area at the time this report was prepared. The conclusions, recommendations and opinions presented in this report are based on our professional knowledge, judgment and experience. No warranty, express or implied, applies to our services and this report.

Any electronic form, facsimile or hard copy of the original document (email, text, table and/or figure), if provided, and any attachments should be considered a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.

Please refer to Appendix F, Report Limitations and Guidelines for Use for additional information pertaining to the use of this report.

9.0 REFERENCES

Chow, V.T., 1959, Open-channel hydraulics: New York, McGraw-Hill, 680 p.

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Rafferty, M. 2016. Computational Design Tool for Evaluating the Stability of Large Wood Structures. Technical Note TN-103.1. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, National Stream & Aquatic Ecology Center. 27 p.

US Army Corps of Engineers (USACE) Hydrologic Engineering Center, February 2016. HEC-RAS River Analysis System, 2D Modeling User's Manual. Version 5.0.

FIGURES

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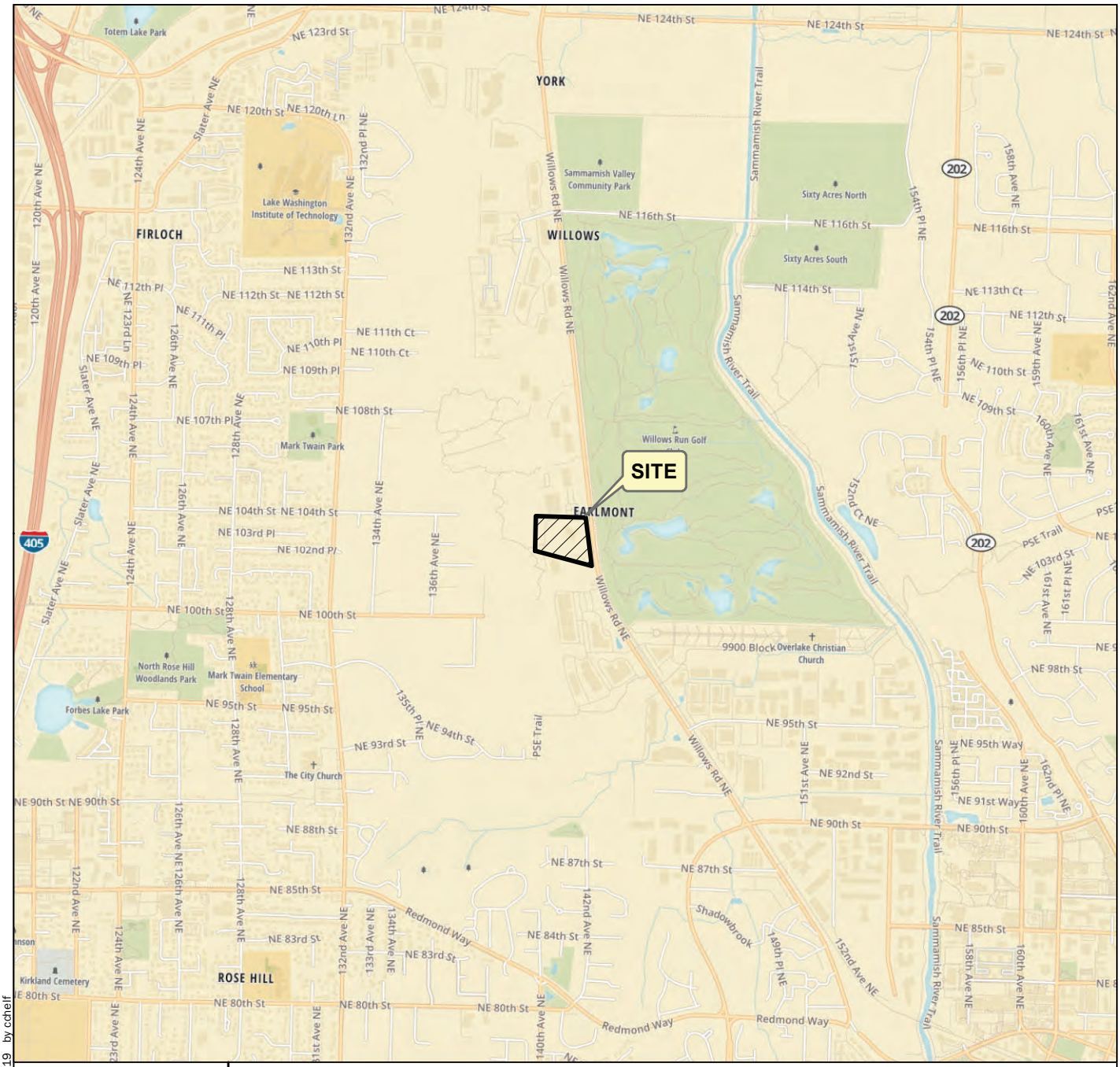

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Feet

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Mapbox Open Street Map, 2017

Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Vicinity Map

Building X
Redmond, Washington

GeoEngineers

Figure 1

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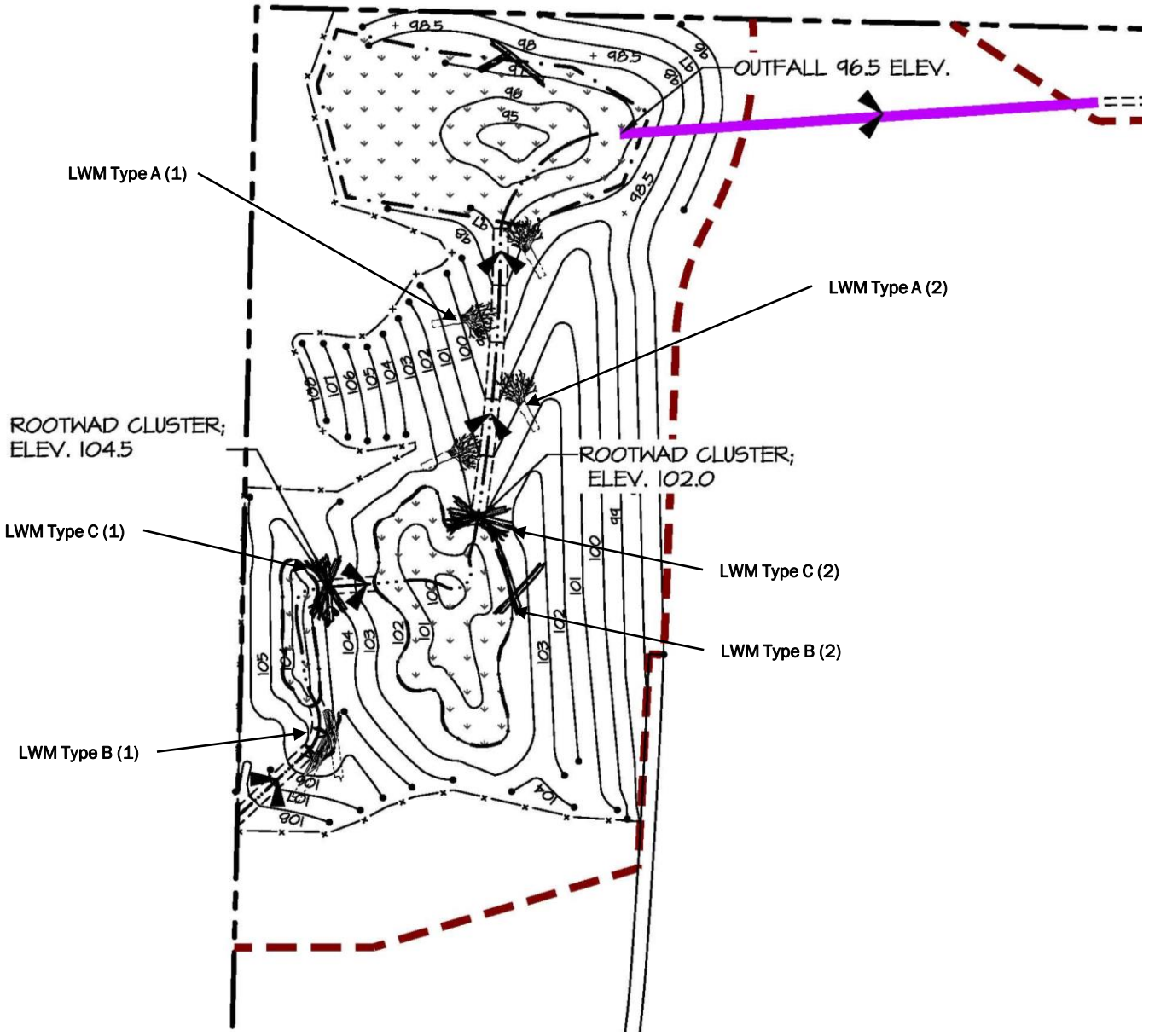


Not to Scale

LWM Plan View

Building X
Redmond, Washington

GeoEngineers

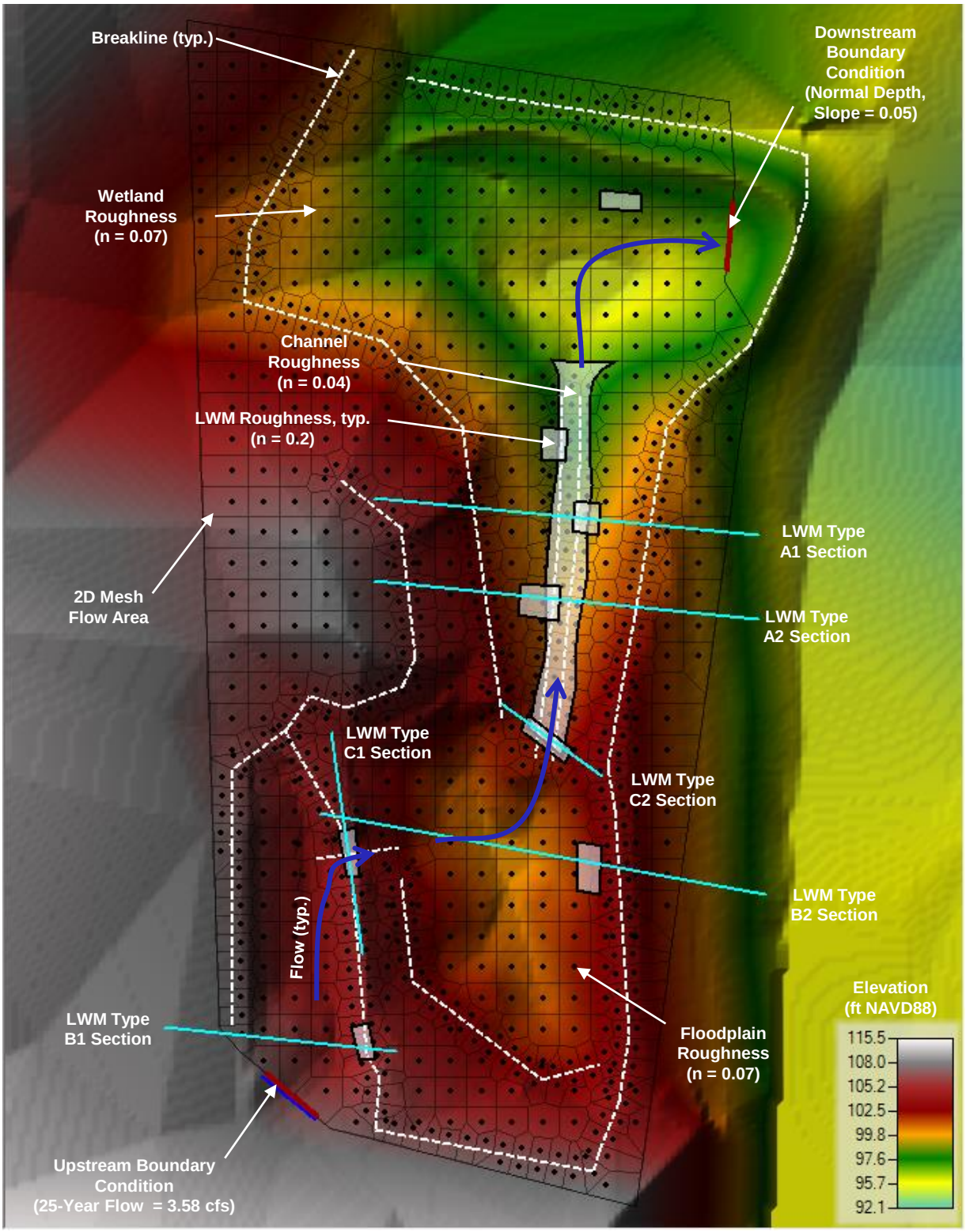
Figure 2

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Talaaea

23237-002-01 Date Exported: 10/08/2019



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Notes:

1. The locations of all features shown are approximate.
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Data Source: CPL (Terrain)

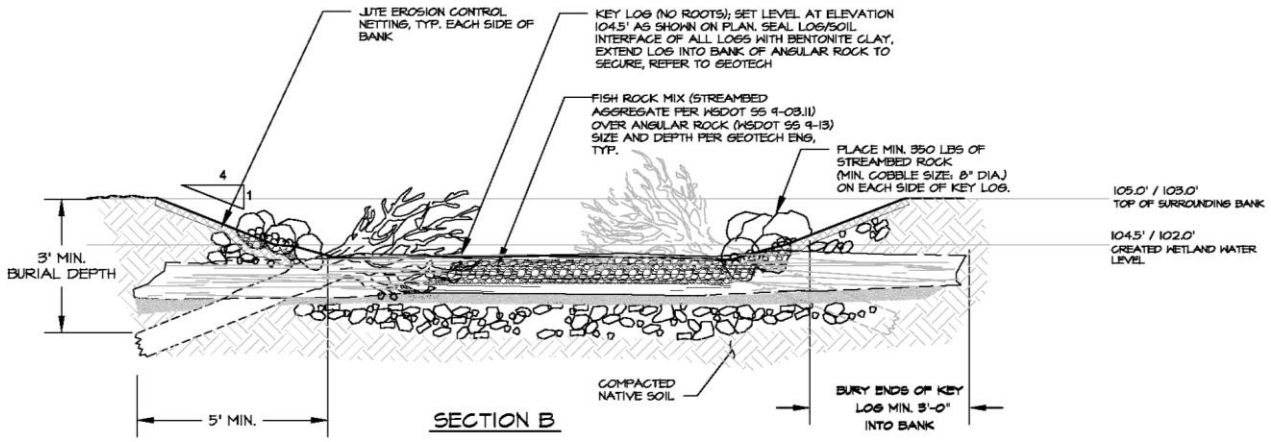
HEC-RAS Schematic

Building X
Redmond, Washington

GeoEngineers

Figure 3

23237-002-01 Date Exported: 10/08/2019



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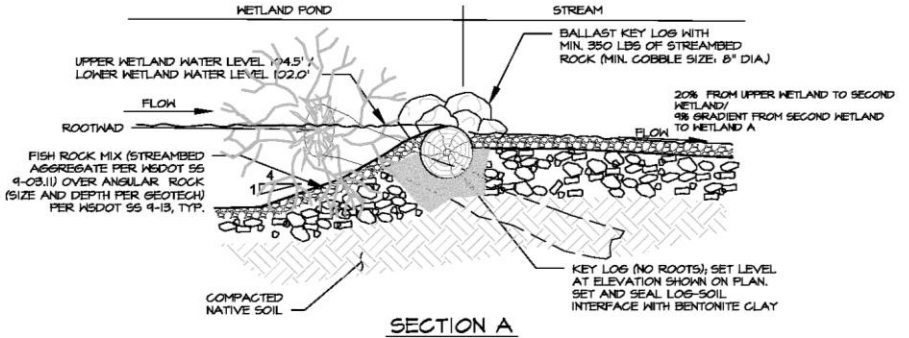
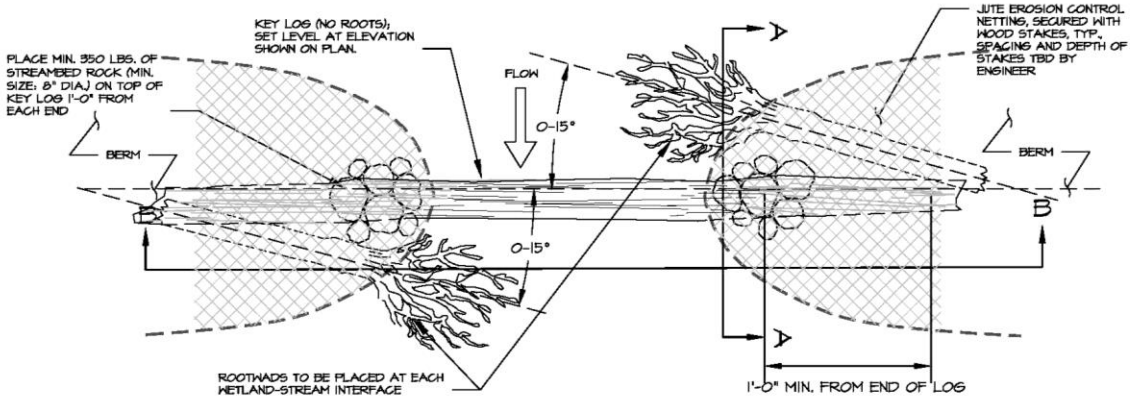


SECTION A



INSTALLATION NOTES:

1. WATER LEVEL CONTROL STRUCTURE SHALL BE INSTALLED WHERE SHOWN ON GRADING PLAN.
2. PACK BENTONITE AROUND LOG/SOIL INTERFACE OF ALL LOGS TO PREVENT SEEPAGE AND EROSION AROUND LOGS.
3. SECURE EACH KEY LOG BY BURYING ENDS INTO BERM SLOPES AND ANCHOR WITH SMALL BOULDERS.
4. STABILIZE BERM SLOPES ADJACENT TO KEY LOG WITH JUTE EROSION CONTROL NETTING AND MULCH.
5. MINIMUM KEY LOG LENGTH: 12 FEET
   MINIMUM KEY LOG DIAMETER: 12 INCHES
6. MINIMUM ROOTWAD STEM LENGTH: 8 FEET
   MINIMUM ROOTWAD STEM DIAMETER: 10 INCHES
   LOG SPECIES: WESTERN RED CEDAR
7. DEPTHS, ANGLES AND EXTENT OF ROOTWAD STEMS AND KEY LOG PLACEMENTS AS SHOWN.

1 WATER LEVEL CONTROL DETAIL

SCALE: NTS

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Talaaea

LWM Type C Stability Recommendations

Building X
Redmond, Washington

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Figure 4

23237-002-01 Date Exported: 10/08/2019

APPENDICES

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APPENDIX A
LWM Risk Evaluation and Design Criteria

Large Woody Material - Risk Assessment Workbook

Project Name	Building X	**Site**	Building X
Project Number	23237-002-01	**Structure**	LWM
Watercourse	Proposed Channel	**Analyst**	AKM
		Latest Revision	9/11/2019
		Checked By:	MCK

Workbook Description

-This workbook contains spreadsheets that facilitate the analysis and/or design of this project
- This spreadsheet lists the general project and workbook information that is consistent throughout the workbook
-It also lists the title of the spreadsheets contained in this workbook
-Only input data into the BLUE shaded cells
-Outputs will be shown in RED shaded cells and automatically updated in graphs

Filename:

https://projects.geoengineers.com/sites/2323700201/Technical Analysis/T900 - LWM Stability/LWM/[Buliding X - Large Woody Material - Risk Assessment.xlsx]Public Safety

Sheet Titles:

Large Woody Material - Risk Assessment Workbook
Public Safety Risk Matrix
Property Damage Risk Matrix
Minimum Design Requirements
Printable Safety Risk Matrix
Printable Property Damage Matrix
Reference Tables

Public Safety Risk Matrix

Project Name Building X
Project Number 23237-002-01
Watercourse Proposed Channel

Site Building X
Structure LWM
Analyst AKM
Latest Revision 9/11/2019
Checked By: MCK

Structure Characteristics

Score	Factor	Description
2	Active Channel	This factor rates the level of use that can be expected within the project reach by recreationalists and is typically for those floating the river in a water craft; however, it can also account for people using the project reach for swimming and other in-river activities, as appropriate. Initially, potential use should be estimated through interviews of local user groups and a review of pertinent published guides and internet sources.
3	Outside of Bend	This factor rates the location of the LWM structure design inside or outside of a bend. This factor rates the likelihood or potential that a recreationalist may be forced into the structure by the primary stream forces or flow characteristics within the channel. The smaller the radius of curvature of the bend (greater the tortuosity) or the greater percentage of stream momentum concentrated in the direction of the LWM structure, the higher this rating shall be.
4	Strainer Potential	This factor rates the potential for a structure to pin or entrap a person against it. Structures that have some porosity or protrusions may have a higher potential to pin or entrap an individual. LWM elements may be designed to provide an amount of porosity with elements that are meant to snag flotsam in the river to enhance the habitat complexity and formation. LWM structures such as these would be rated high. Some LWM structures are filled with rock material creating a nearly solid structure and can contain smooth outer edges designed as hydraulic features for restoration needs. These structures can be rated low and the rating is dependent on the actual design features.
2	Egress Potential	This factor rates the ease of avoidance for a person floating or swimming in the area of the structure. This includes avoiding the structure in terms of potential stream currents upstream and at the structure. Additionally, this factor should rate the ability to get around the structure through a clear navigable or walkable path. In a narrow stream with a LWM structure that extends significantly into the stream current, this factor could be rated high. For a wide river with uniform flow current and a small LWM structure placed on one bank, this factor could be rated low. Additional bank condition factors to consider might be a deeply incised channel or a channel with dense thorny vegetation on its banks where exiting and walking around a structure may be difficult. In these particular situations, the factor may be rated higher.
2	Sight Distance	This factor rates the ability for recreationalists to see the structure and have the time to move away as they approach from upstream. This factor rates both the ability to see the structure from upstream as well as the rate at which one approaches. This factor should be considered for periods in which recreationalists are either known or thought to utilize the stream reach (i.e., spring or summer rafting season, or fall fishing season). Sight distance should consider obstructions to view, slope of river upstream, velocity of river, width of river, and length of approach from LWM structure location when readily visible. A LWM structure located immediately around a bend with limited ability to see in a swift stream would be rated high for this factor. A LWM structure located in a straight and wide reach of a slow moving river that is clearly seen at all river flows could be rated low for this factor.
5	Depth x Velocity	This factor rates channel approach velocity and depth to define the safety of standing and moving away or around the structure. For a situation where a person swimming in the stream and approaching the structure can reasonably stand and walk around the structure, a low rating could be applied. For any structure in which wading in the river as one approaches or arrives at the structure is difficult, a high rating would likely apply. As a guide, a low rating could result from a velocity depth product of 0 to 2, a moderate rating could result from a velocity-depth product of 3 to 5, and a high rating could result from a velocity-depth product of 6 and above. However, the individual rating for this factor must be made by the design team for reasonable case specific circumstances to be encountered.
18.0	**Total**	
3.0	**Average Score**	

Reach-User Characteristics

Score	Factor	Description
1	Frequency of Use	This factor rates the level of use that can be expected within the project reach by recreationalists and is typically for those floating the river in a water craft; however, it can also account for people using the project reach for swimming and other in-river activities, as appropriate. Initially, potential use should be estimated through interviews of local user groups and a review of pertinent published guides and internet sources. For example, a reach of river that is frequented by an established guide company for use of inner-tubing or that is frequently used by the general public for such purposes would be rated high. Similarly, if the reach is known for intense fishing or is listed as such within fishing guides or other sources, it would be rated a high score. Conversely, a reach of river where use is unknown and not documented as being used by anyone could be rated low.
1	Skill Level	This factor rates the risk associated with the recreational skill level of users in the project reach and can be applied to people floating the reach or by swimming ability in locations where public tend to swim. For people floating the reach, craft type and safety equipment use could be factored into the risk assessment (i.e., low-skilled inner-tubers to highly-trained whitewater boaters). For example, a reach that is used by a range of individuals in which limited or no knowledge of river safety is practiced would be rated as low skill level and would likely receive a high numerical rating as having a greater risk hazard. Conversely, a reach that is only used by highly advanced and trained boaters with proper safety equipment would be rated as high skill level and could receive a lower numerical rating as having a lesser risk hazard if LWM conditions were already expected to be encountered in the reach.
4	Access	This factor rates the risk of having the public recreating in the project reach by accessibility. A reach with good access that is provided by a public boat ramp or park could be rated as high. A reach with access from nearby bridges or non-public, but utilized locations might be considered moderate, and a site with no nearby access provided by public roads and difficult terrain may be rated as low. Good access would receive a higher numerical risk rating, whereas poor access would receive a lower numerical risk rating. Individual ratings must be decided by the project design team and be based on local research of reach use.
1	Child Presence	This factor rates the public safety risk at the project reach for the presence of children and is used to factor locations where children are known to be present and may be prone to investigate LWM structures to play on or near. As an example, a reach located adjacent to a summer camp for children would likely have a high numerical risk rating. Conversely, a location with difficult access and not near any location where children are known to be present would likely have a low numerical risk rating. Individual ratings must be decided by the project design team and be based on local research of local known uses.
7.0	**Total**	
1.8	**Average Score**	

Property Damage Risk Matrix

Project Name: Building X
Project Number: 23237-002-01
Watercourse: Proposed Channel

Site: Building X
Structure: LWM
Analyst: AKM
Latest Revision: 9/11/2019
Checked By: MCK

Stream Response Potential

Score	Factor	Description
4	Stream Type	This factor rates the potential for stream response based on the stream's type and slope within the project reach. Identification of the stream type can be used to determine a stream's potential sensitivity to disturbance. Using Montgomery and Buffington's classification system (Montgomery and Buffington 1998) or other methods, one can estimate a stream's physical sensitivity to change. A project located in a source reach with a bedrock channel and a high slope may be rated as having a very low sensitivity. A project located in a response reach within an alluvial channel and low slope may be rated as having a high sensitivity. Individual ratings must be decided by the project design team.
7	Riparian Corridor	This factor rates the project reach's ability to respond to change through natural riparian resilience. The capacity of the stream to absorb disturbances without harm to habitat or property, often referred to as resilience, generally increases with the width of the riparian corridor (USFWS 2009). Additionally, the probability that the stream may be adversely affected increases when the riparian corridor is narrow or discontinuous. A project in a location with a relatively wide riparian corridor in comparison to stream width would be rated low. Whereas, the risk associated with morphologic response is greatest in urban and levee-confined streams that lack the space necessary to respond to disturbances (USFWS 2009). Individual ratings must be decided by the project design team.
5	Bed Scour	This factor rates the project reach's physical susceptibility to bed changes. Channels with highly mobile or erodible bed material such as sand or loose gravel will respond to disturbance more rapidly and to a greater degree than those with less erodible bed material. Coarse sediment, particularly immobile material such as boulders, creates streams with much lower scour risk. Individual ratings must be decided by the project design team.
4	Hydrologic Regime	This factor rates the stream's temporal hydrologic variability. Stream systems with evidence of high variability in their hydrograph have a much greater potential for system response and hence a relatively lower channel stability (USFWS 2009). For example, spring-fed stream systems that have little discharge variability and hence are highly stable and predictable and would be rated low. In contrast, convective thunderstorm-driven hydrology that results in streams with high variability and more frequent high flows could be rated high. Additionally, streams that show evidence of hydrologic regime shift from climate change or other factors such as from snowmelt driven to rain-on-snow events are especially susceptible to change and should be rated high. Individual ratings must be decided by the project design team.
5	Bank Erosion Potential	This factor rates the project reach's physical susceptibility to bank erosion based upon bank material composition. Bank erosion is lower in channels with naturally non-erodible bank materials, such as rock or highly cohesive clay. Conversely, erosion is higher in channels with banks that are highly erodible due to their material composition such as sand or loosely deposited alluvium. This factor rates the project reach's physical susceptibility to bank changes. Individual ratings must be decided by the project design team.
25.0	**Total**	
5.0	**Average Score**	

Property/Project Characteristics

Score	Factor	Description
6	In-channel Structures	This factor weighs the amount, type, and vulnerability of in channel structures present in or near the project to LWM. In-channel structures can include bridges, piers, docks, intakes, pumps, fish screens, and any other placed features in the channel area. The distance for evaluation of structures upstream and downstream of the LWM project must be decided by the design team and based on physical conditions and project stakeholder consideration. A project with no structures located in the determined damage area of a project could be rated as 0. A project that has multiple vulnerable structures in the determined potential damage area or a structure with multiple piers and no freeboard could be rated 10. Individual ratings must be decided by the project design team. The decisions on the distance to consider for potential damages needs to be clearly documented by the design team.
6	Floodplain Structures	This factor weighs the amount, type, and vulnerability of structures within the 100-year floodplain influenced by the project to flood changes. A project that has no constructed structures in the 100-year floodplain could be rated low. A project that has multiple residences within the 100-year floodplain and at or only minimally above it could be rated high. Individual ratings must be decided by the project design team.
6	Land Use	This factor attempts to determine the property damage potential by land use category. A qualitative assessment is performed by the design team and is based on project stakeholder input. Flood prone land uses that are highly susceptible to either flood effects or channel migration would receive higher ratings than natural land uses. For example, an area in which floodplains are used for agricultural of high value crops that are grown during a common flood season may receive a higher rating than an area where natural uses are predominant. As another example, a project that is completely located on National Forest lands may be rated as low. A project that is within an urban area with exposed channel banks could be rated as high. Significant farm land or rural residential may receive a moderate rating. Individual ratings must be decided by the project design team.
18.0	**Total**	
6.0	**Average Score**	

Minimum Design Requirements

Project Name:	Building X	**Site:**	Building X
Project Number:	23237-002-01	**Structure:**	LWM
Watercourse:	Proposed Channel	**Analyst:**	AKM
		Latest Revision:	9/11/2019
		Checked By:	MCK

Public Safety Risk	**Low**
Property Damage Risk	**Moderate**
Ref.	**Low-Moderate**

Stability Design Criteria	**25-year**

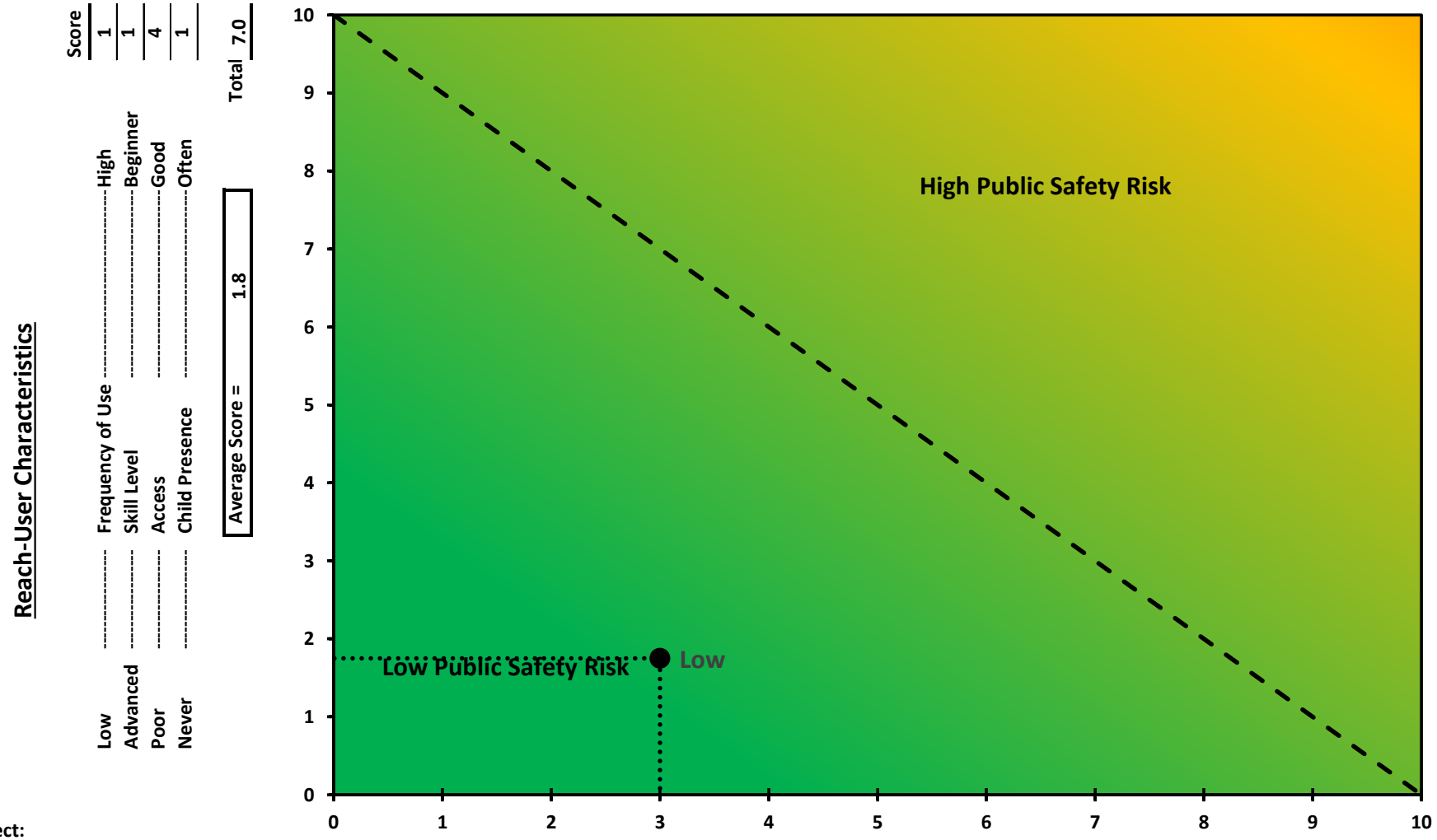
Factor of Safety Requirements	
$FOS_{sliding}$	**1.5**
$FOS_{bouyancy}$	**1.75**
$FOS_{rotation}$ / $FOS_{overtuning}$	**1.5**

Hydraulic Model Requirements	
River Use Survey Needs	**Literature Review**
Geomorphic Assessment Needs	**Rapid**
Design Team Needs	**PE, FG, FB**
Hydraulic Model Requirements	**1 dimensional**

Note: Due to the site grading plans, with large areas of storage in the wetland, a 2 dimensional hydraulic model was used.

Public Safety Risk Matrix

Structure Description: LWM



Project:
Building X

Evaluator:
AKM

Concurrence:
MCK

Date:
9/11/2019

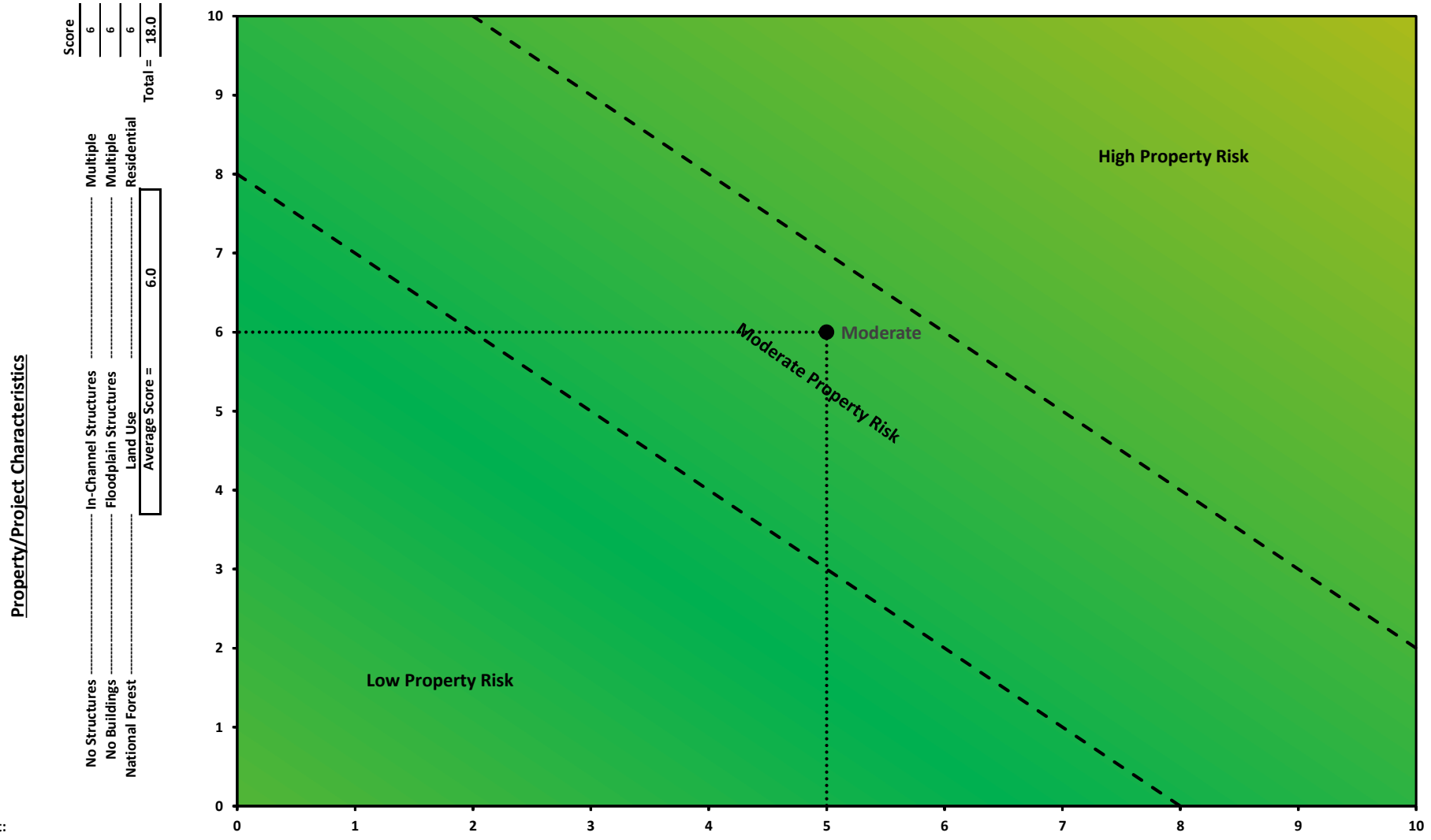
					Score
No	----------	Active Channel?	----------	Yes	2
No	----------	Outside of Bend?	----------	Yes	3
Low	----------	Strainer Potential	----------	High	4
High	----------	Egress Potential	----------	Low	2
High	----------	Sight Distance	----------	Low	2
Low	----------	Depth x Velocity	----------	High	5

Average Score = 3.0

Total Score = 18.0

Property Damage Risk Matrix

Structure Description: LWM



					Score
Stream Type:	Bedrock (source >10%)		Transport (3-10%)	Response (<3%)	4
Riparian Corridor:	Continuous/Wide		Discontinuous/narrow	Urbanized/Levee Confined	7
Bed Scour:	Boulder/Clay bed		Gravel/Cobble	Sand/Silt	5
Hydrologic Regime:	Spring-fed	Snowmelt	Rain	Rain-on-Snow	Thunderstorm	4
Bank Erosion:	Naturally Non-erodible		Erosion Resistant	Highly Erodible	5
			Average Score = 5.0	Total Score =	25.0

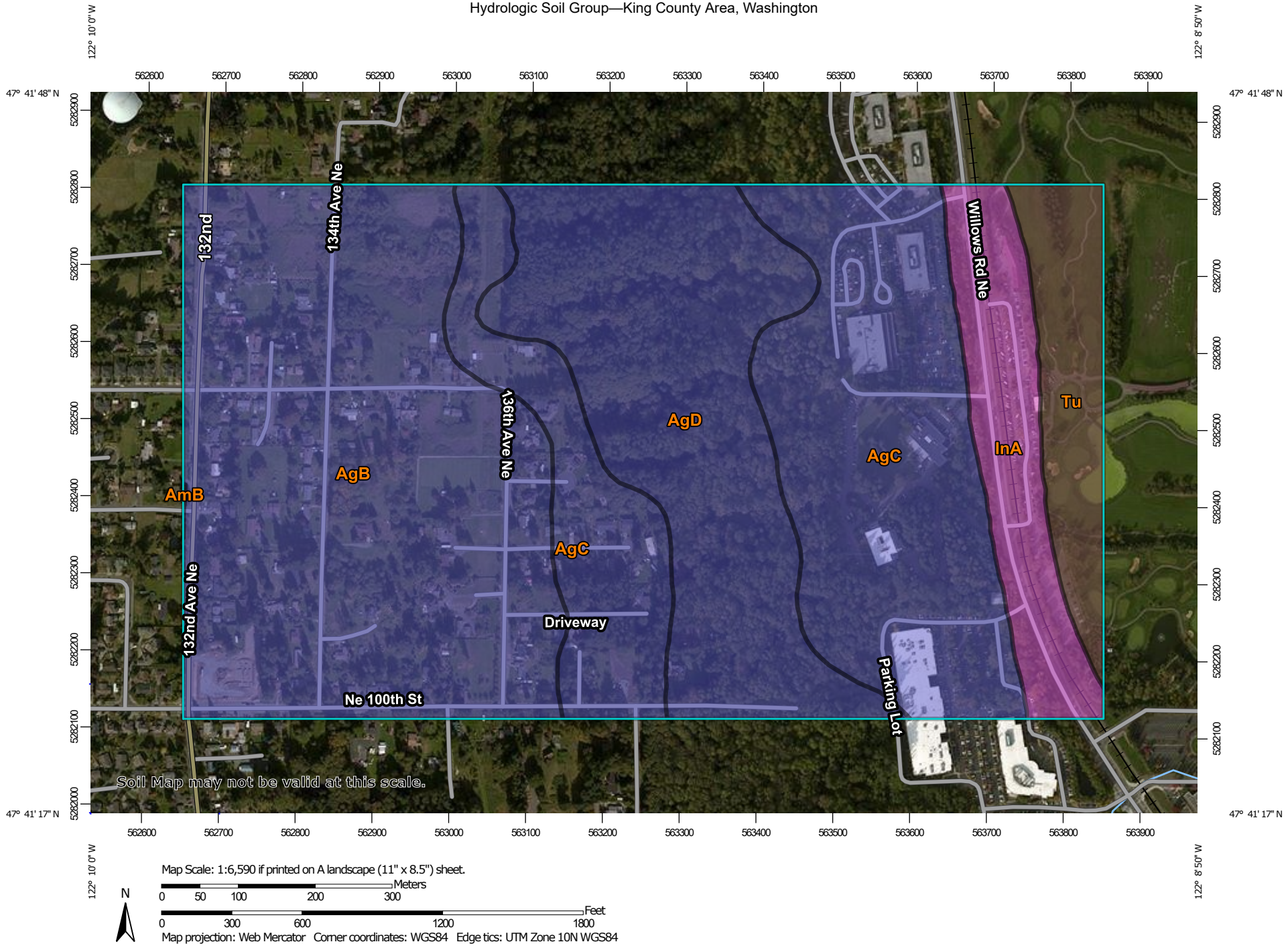
Project: Building X

Evaluator: AKM

Concurrence: MCK

Date: 9/11/2019

APPENDIX B
Web Soil Survey


122° 10' 0" W
122° 8' 50" W
47° 41' 48" N
47° 41' 17" N
562600
562700
562800
562900
563000
563100
563200
563300
563400
563500
563600
563700
563800
563900
5282900
5282800
5282700
5282600
5282500
5282400
5282300
5282200
5282100
5282000
132nd
134th Ave Ne
136th Ave Ne
132nd Ave Ne
Willows Rd Ne
Ne 100th St
Driveway
Parking Lot
AgB
AgC
AgD
AmB
InA
Tu
Soil Map may not be valid at this scale.
Map Scale: 1:6,590 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0 50 100 200 300
Feet
0 300 600 1200 1800
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: King County Area, Washington
Survey Area Data: Version 14, Sep 10, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 31, 2013—Oct 6, 2013

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
AgB	Alderwood gravelly sandy loam, 0 to 8 percent slopes	B	74.5	36.2%
AgC	Alderwood gravelly sandy loam, 8 to 15 percent slopes	B	60.0	29.1%
AgD	Alderwood gravelly sandy loam, 15 to 30 percent slopes	B	43.9	21.3%
AmB	Arents, Alderwood material, 0 to 6 percent slopes	B/D	0.0	0.0%
InA	Indianola loamy sand, 0 to 5 percent slopes	A	15.6	7.5%
Tu	Tukwila muck	B/D	12.1	5.9%
Totals for Area of Interest			**206.2**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX C
Western Washington Hydraulic Model Output

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	BlgX_WWHM Combined
Site Name:	
Site Address:	
City:	
Report Date:	9/11/2019
Gage:	Seatac
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2018/10/10
Version:	4.2.16

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data

Predeveloped Land Use

North Upstream Sub-basin

Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Lawn, Mod	2.44
A B, Lawn, Steep	2.02
Pervious Total	4.46

Impervious Land Use	acre
ROADS FLAT	0.11
ROADS MOD	0.33
ROADS STEEP	3.75
Impervious Total	4.19
Basin Total	8.65

Element Flows To:

Surface	Interflow	Groundwater

On-site Sub-basin

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
A B, Lawn, Steep	0.34
Pervious Total	0.34

Impervious Land Use	acre
Impervious Total	0
Basin Total	0.34

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Routing Elements
Predeveloped Routing

Mitigated Routing

Analysis Results

POC 1

POC #1 was not reported because POC must exist in both scenarios and both scenarios must have been run.

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

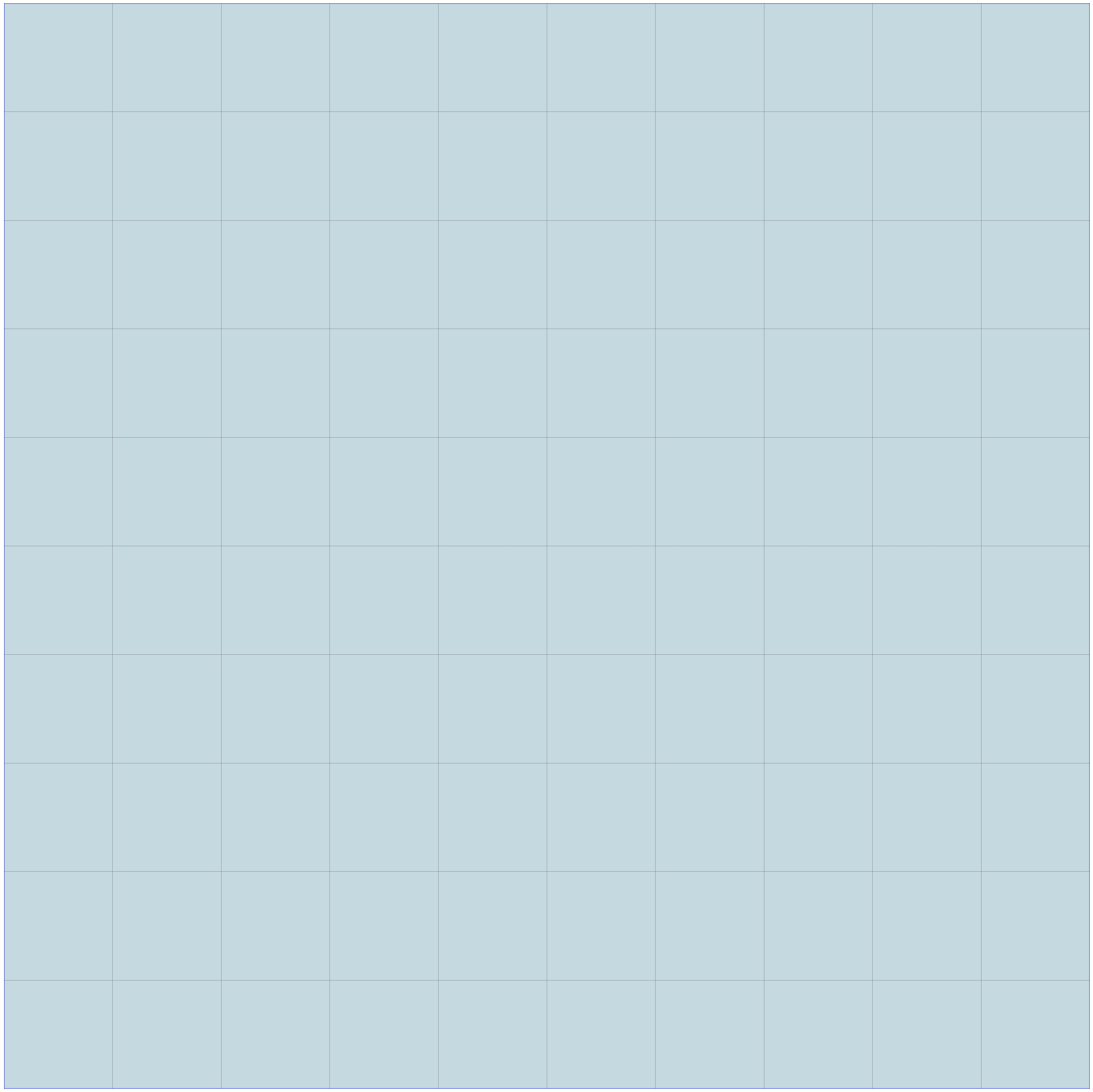
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic

Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM         26   BlgX_WWHM Combined.wdm
MESSU       25   PreBlgX_WWHM Combined.MES
            27   PreBlgX_WWHM Combined.L61
            28   PreBlgX_WWHM Combined.L62
            30   POCBlgX_WWHM Combined1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       8
      PERLND       9
      IMPLND       1
      IMPLND       2
      IMPLND       3
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        North Upstream Sub-basin    MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
    8     A/B, Lawn, Mod          1    1    1    1   27    0
    9     A/B, Lawn, Steep        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
    8         0    0    1    0    0    0    0    0    0    0    0    0
    9         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
```

```
  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
    8         0    0    4    0    0    0    0    0    0    0    0    0    1    9
    9         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
    8         0    0    0    0    0    0    0    0    0    0    0
    9         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
    8              0         5       0.8       400       0.1       0.3     0.996
    9              0         5       0.8       400      0.15       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    8              0         0         2         2         0         0         0
    9              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                              ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    8          0.1       0.5      0.25         0       0.7      0.25
    9          0.1       0.5      0.25         0       0.7      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
               ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
    8              0         0         0         0         3         1         0
    9              0         0         0         0         3         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
    2      ROADS/MOD              1    1    1   27    0
    3      ROADS/STEEP            1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections ******************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
    2         0    0    1    0    0    0
    3         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
    2         0    0    4    0    0    0    1    9
    3         0    0    4    0    0    0    1    9
  END PRINT-INFO
```

```
  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
    2         0    0    0    0    0
    3         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
    2            400      0.05       0.1      0.08
    3            400       0.1       0.1      0.05
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    2              0         0
    3              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    2              0         0
    3              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
North Upstream Sub-basin ***
PERLND   8                        2.44     COPY   501     12
PERLND   8                        2.44     COPY   501     13
PERLND   9                        2.02     COPY   501     12
PERLND   9                        2.02     COPY   501     13
IMPLND   1                        0.11     COPY   501     15
IMPLND   2                        0.33     COPY   501     15
IMPLND   3                        3.75     COPY   501     15
On-site Sub-basin***
PERLND   9                        0.34     COPY   501     12
PERLND   9                        0.34     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                       in  out                              ***
  END GEN-INFO
```

```
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections ****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit      possible  exit
            *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
         *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK
```

```
END RUN
```

Mitigated UCI File

Predeveloped HSPF Message File

Mitigated HSPF Message File

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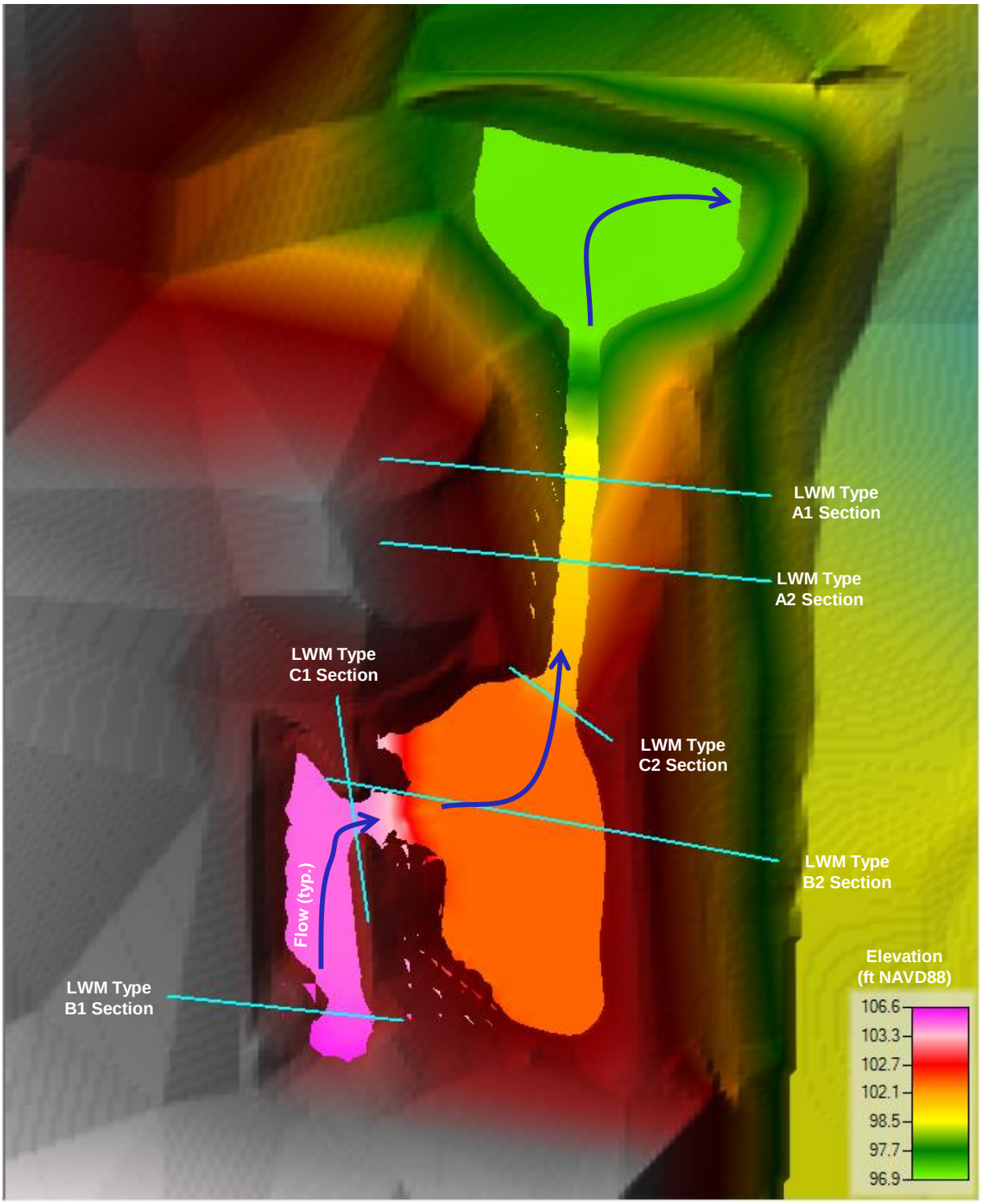
APPENDIX D
HEC-RAS Output



N
W E
S

Not to Scale

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. The projection is set to NAD 1983 State Plane Washington North, US Feet.
4. Elevations presented within the color scale are in feet.

Data Source: CPL (terrain)

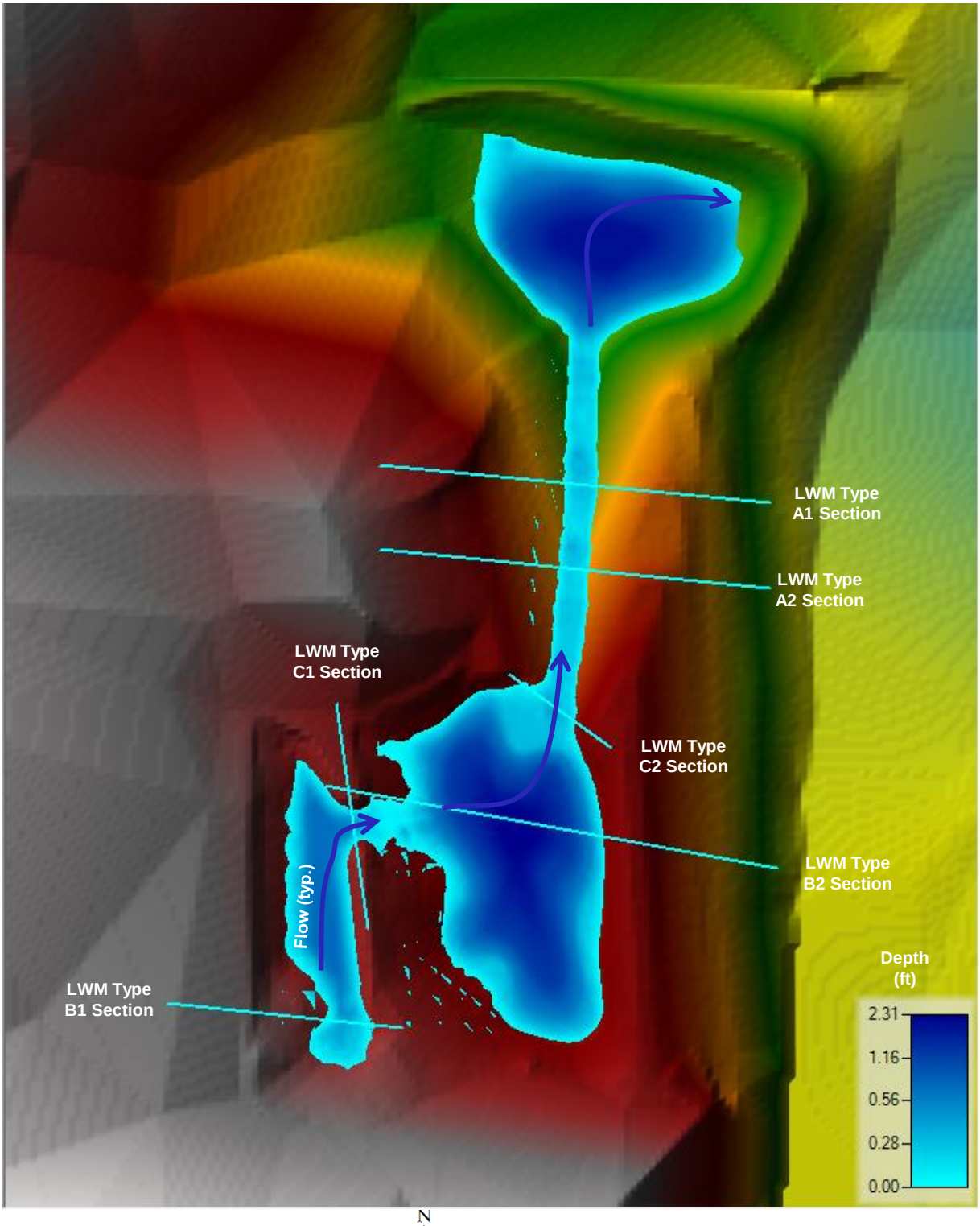
25-Year Water Surface Elevations

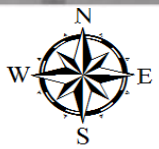
Building X
Redmond, Washington

GeoEngineers

Figure D-1

23237-002-01 Date Exported: 09/13/19





Not to Scale

Notes:

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3. The projection is set to NAD 1983 State Plane Washington North, US Feet.
4. Water depths presented within the color scale are in feet.

Data Source: CPL (terrain)

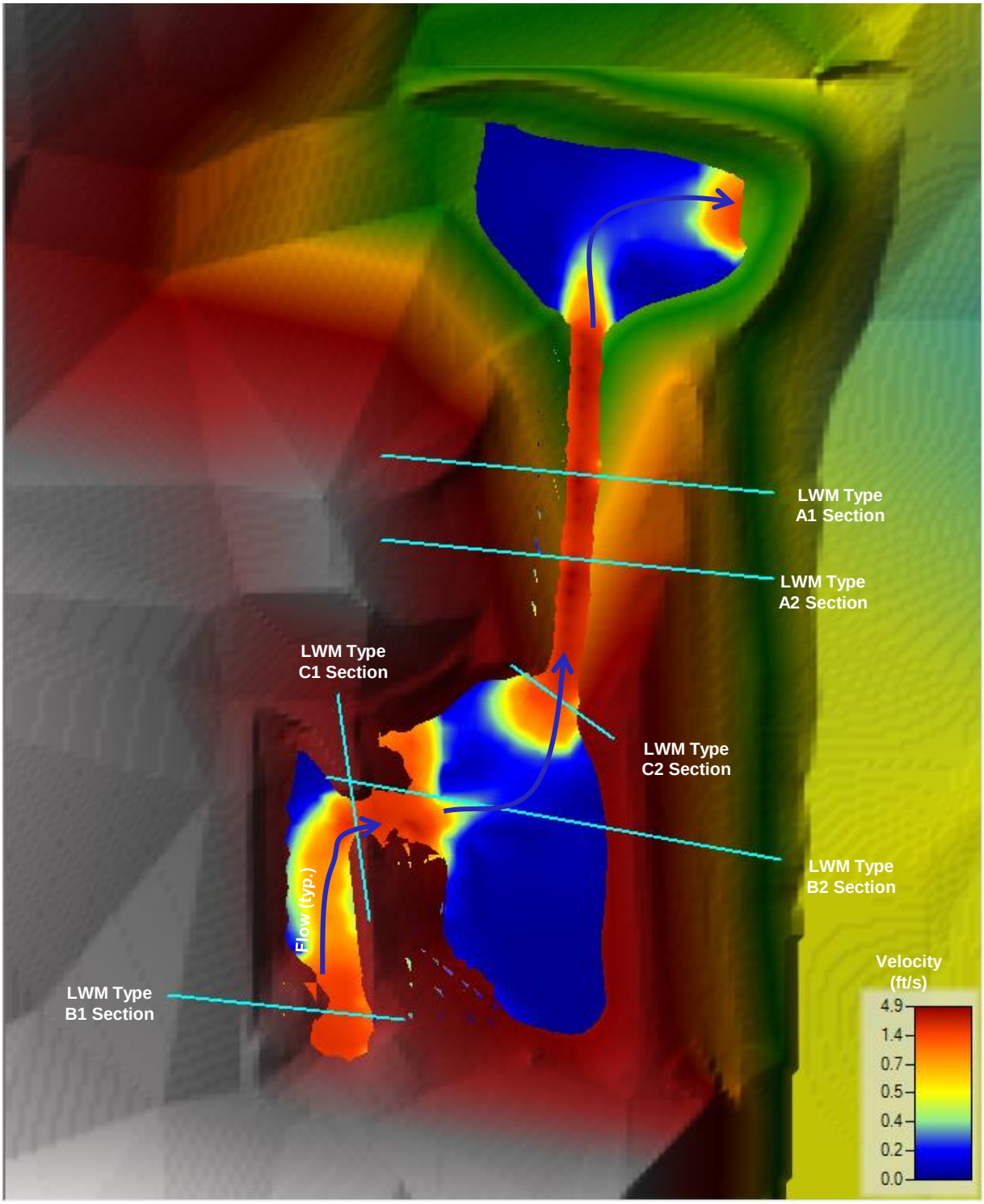
25-Year Water Depth

Building X
Redmond, Washington

GeoEngineers

Figure D-2

23237-002-01 Date Exported: 09/13/19



N
W E
S

Not to Scale

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. The projection is set to NAD 1983 State Plane Washington North, US Feet.
4. Velocities presented within the color scale are in feet per second.

Data Source: CPL (terrain)

25-Year Velocities

Building X
Redmond, Washington

GeoEngineers

Figure D-3

23237-002-01 Date Exported: 09/13/19

APPENDIX E
LWM Stability Calculations

Building X

Large Wood Structure Stability Analysis

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Date of Last Revision: October 8, 2019

Designer:
Alex Morton, EIT

Reviewed by:
Melanie Klym, PE

Large Wood Structure Stability Analysis Spreadsheet was developed by Michael Rafferty, P.E.
Version 1.1

Reference for Companion Paper:

Rafferty, M. 2016. *Computational Design Tool for Evaluating the Stability of Large Wood Structures.* Technical Note TN-103.1. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, National Stream & Aquatic Ecology Center. 27 p.

Building X
Factors of Safety and Design Constants

Spreadsheet developed by
Michael Rafferty, P.E.

Symbol	Description	Value
FS_V	Factor of Safety for Vertical Force Balance	**1.75**
FS_H	Factor of Safety for Horizontal Force Balance	**1.50**
FS_M	Factor of Safety for Moment Force Balance	**1.50**

Symbol	Description	Units	Value
C_{Lrock}	Coefficient of lift for submerged boulder (D'Aoust, 2000)	-	0.17
C_{Drock}	Coefficient of drag for submerged boulder (Schultz, 1954)	-	0.85
g	Gravitational acceleration constant	ft/s^2	32.174
DF_{RW}	Diameter factor for rootwad ($DF_{RW} = D_{RW}/D_{TS}$)	-	3.00
LF_{RW}	Length factor for rootwad ($LF_{RW} = L_{RW}/D_{TS}$)	-	1.50
SG_{rock}	Specific gravity of quartz particles	-	2.65
γ_{rock}	Dry unit weight of boulders	lb/ft^3	165.0
γ_w	Specific weight of water at 50ºF	lb/ft^3	62.40
η	Rootwad porosity from NRCS Tech Note 15 (2001)	-	0.20
ν	Kinematic viscosity of water at 50ºF	ft/s^2	1.41E-05

Building X
Hydrologic and Hydraulic Inputs

Spreadsheet developed by
Michael Rafferty, P.E.

Average Return Interval (ARI) of Design Discharge: 25 yr

Site ID	Proposed Station	Design Discharge, Q_{des} (cfs)	Maximum Depth, d_w (ft)	Average Velocity, u_{avg} (ft/s)	Bankfull Width, W_{BF} (ft)	Wetted Area, A_W (ft^2)	Radius of Curvature, R_c (ft)
LWM - Type A (1)	1+23	3.58	0.30	3.71	6.0	1.2	1,000
LWM - Type A (2)	1+09	3.58	0.30	3.28	6.0	1.2	1,000
LWM - Type B (1)	0+04	3.58	0.50	2.10	7.0	1.8	15
LWM - Type B (2)	0+68	3.58	1.15	1.74	30.0	20.1	1,000
LWM - Type C (1)	0+40	3.58	0.60	2.15	5.0	2.1	1,000
LWM - Type C (2)	0+83	3.58	0.40	1.85	8.0	2.0	1,000

Building X
Stream Bed Substrate Properties

Spreadsheet developed by
Michael Rafferty, P.E.

Site ID	Proposed Station	Stream bed D_{50} (mm)	Stream Bed Substrate Grain Size Class	Bed Soil Class	Dry Unit Weight[1], γ_{bed} (lb/ft^3)	Buoyant Unit Weight, γ'_{bed} (lb/ft^3)	Friction Angle, ϕ_{bed} (deg)
LWM - Type A (1)	1+23	25.40	Coarse gravel	5	126.2	78.6	38
LWM - Type A (2)	1+09	24.50	Coarse gravel	5	125.9	78.4	38
LWM - Type B (1)	0+04	24.50	Coarse gravel	5	125.9	78.4	38
LWM - Type B (2)	0+68	24.50	Coarse gravel	5	125.9	78.4	38
LWM - Type C (1)	0+40	24.50	Coarse gravel	5	125.9	78.4	38
LWM - Type C (2)	0+83	24.50	Coarse gravel	5	125.9	78.4	38

Source: Compiled from Julien (2010) and Shen and Julien (1993); soil classes from NRCS Table TS14E–2 Soil classification

[1] γ_{bed} (kg/m^3) = 1,600 + 300 log D_{50} (mm) (from Julien 2010)

Multi-Log 1 kg/m^3 = 0.062 1 lb/ft^3

Building X
Bank Soil Properties

Spreadsheet developed by
Michael Rafferty, P.E.

Site ID	Proposed Station	Bank Soils (from field observations)	Bank Soil Class	Dry Unit Weight, γ_{bank} (lb/ft^3)	Buoyant Unit Weight, γ'_{bank} (lb/ft^3)	Friction Angle, ϕ_{bank} (deg)
LWM - Type A (1)	1+23	Fine sand, dense	6	114.0	71.0	42
LWM - Type A (2)	1+09	Fine sand, dense	6	114.0	71.0	42
LWM - Type B (1)	0+04	Fine sand, dense	6	114.0	71.0	42
LWM - Type B (2)	0+68	Fine sand, dense	6	114.0	71.0	42
LWM - Type C (1)	0+40	Fine sand, dense	6	114.0	71.0	42
LWM - Type C (2)	0+83	Fine sand, dense	6	114.0	71.0	42

Building X
Large Wood Properties

Spreadsheet developed by
Michael Rafferty, P.E.

Project Location: West Coast

Timber Unit Weights			Air-dried[1]	Green[2] γ_{Tgr}
Selected Species	Common Name	Scientific Name	γ_{Td} (lb/ft^3)	(lb/ft^3)
Tree Type #1:	Cedar, Western redcedar	Thuja plicata	22.4	27.0
Tree Type #2:				
Tree Type #3:				
Tree Type #4:				
Tree Type #5:				
Tree Type #6:				
Tree Type #7:				
Tree Type #8:				
Tree Type #9:				
Tree Type #10:				

[1] **Air-dried unit weight, γ_{Td}** = Average unit weight of wood after exposure to air on a 12% moisture content volume basis. Air-dried unit weight is used in the force balance calculations for the portion of wood that is above the proposed thalweg elevation (assuming unsaturated conditions).

[2] **Green unit weight, γ_{Tgr}** = Average unit weight of freshly sawn wood when the cell walls are completely saturated with water. Green unit weight is used in the force balance calculations as a conservative estimate of the unit weight for the portion of wood that is below the proposed thalweg elevation (assuming saturated conditions). For comparison, Thevenet, Citterio, & Piegay (1998) determined wood unit weight typically increases by more than 100% after less than 24 hours exposure to water.

Source for timber unit weights:

U.S. Department of Agriculture, U.S. Forest Service. (2009) Specific Gravity and Other Properties of Wood and Bark for 156 Tree Species Found in North America. Research Note NRS-38. Table 1A.

Building X

Spreadsheet developed by
Michael Rafferty, P.E.

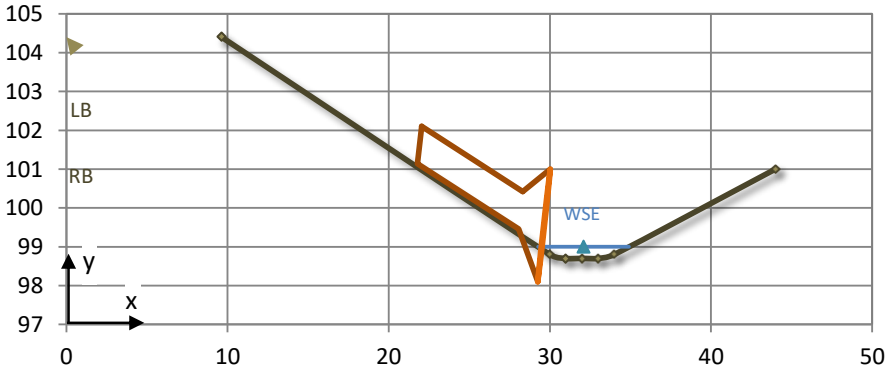
Single Log Stability Analysis Model Inputs

Site ID	Structure Type	Structure Position	Meander	Station	d_w (ft)	R_c/W_{BF}	u_{des} (ft/s)
LWM - Type A (1)	Rootwad	Left bank	Straight	1+23	0.30	166.67	3.71

Multi-Log Structures	Layer	Log ID
	Key Log	RW1

Channel Geometry Coordinates		
Proposed	x (ft)	y (ft)
Fldpln LB	9.63	104.40
Top LB	30.00	98.80
Toe LB	31.00	98.70
Thalweg	32.00	98.70
Toe RB	33.00	98.70
Top RB	34.00	98.80
Fldpln RB	44.00	101.00

Proposed Cross-Section and Structure Geometry (Looking D/S)



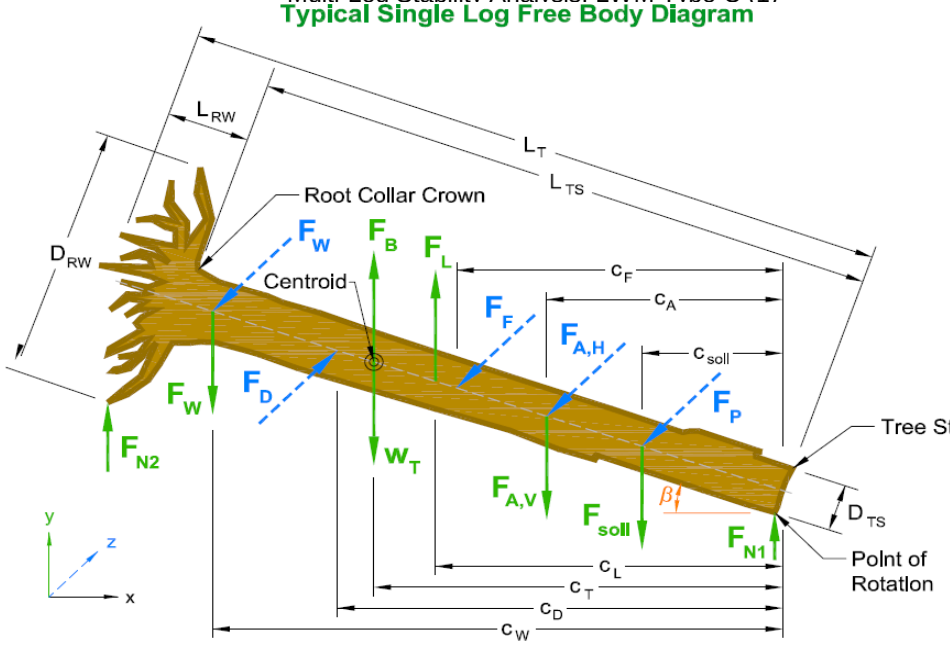
Wood Species	Rootwad	L_T (ft)	D_{TS} (ft)	L_{RW} (ft)	D_{RW} (ft)	γ_{Td} (lb/ft^3)	γ_{Tgr} (lb/ft^3)
Cedar, Western redcedar	Yes	8.0	1.00	1.50	3.00	22.4	27.0

Structure Geometry	θ (deg)	β (deg)	Define Fixed Point	x_T (ft)	y_T (ft)	$y_{T,min}$ (ft)	$y_{T,max}$ (ft)	A_{Tp} (ft^2)
	89.0	15.0	Rootwad: Bottom	29.25	98.10	98.10	102.10	0.02

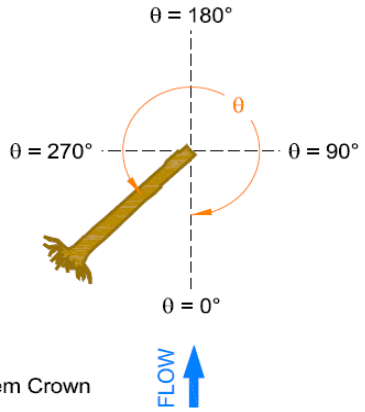
Soils	Material	γ_s (lb/ft^3)	γ'_s (lb/ft^3)	ϕ (deg)	Soil Class	$L_{T,em}$ (ft)	$d_{b,max}$ (ft)	$d_{b,avg}$ (ft)
Stream Bed	Coarse gravel	126.2	78.6	38.0	5	0.00	0.00	0.00
Bank	Fine sand, dense	114.0	71.0	42.0	6	0.00	0.00	0.00

Multi-Log Stability Analysis: LWM Type C (1)

Typical Single Log Free Body Diagram



Log Orientation (Plan View)



Vertical Force Analysis

Net Buoyancy Force

Wood	V_{TS} (ft^3)	V_{RW} (ft^3)	V_T (ft^3)	W_T (lbf)	F_B (lbf)
↑WSE	5.1	3.3	8.4	188	0
↓WS↑Thw	0.0	0.6	0.6	13	35
↓Thalweg	0.0	0.2	0.2	5	12
Total	5.1	4.1	9.2	206	48

Lift Force

C_{LT}	0.00
F_L (lbf)	0

Soil Ballast Force

Soil	V_{dry} (ft^3)	V_{sat} (ft^3)	V_{soil} (ft^3)	F_{soil} (lbf)
Bed	0.0	0.0	0.0	0
Bank	0.0	0.0	0.0	0
Total	0.0	0.0	0.0	0

Vertical Force Balance

F_B (lbf)	48 ↑
F_L (lbf)	0
W_T (lbf)	206 ↓
F_{soil} (lbf)	0
$F_{W,V}$ (lbf)	0
$F_{A,V}$ (lbf)	0
ΣF_V (lbf)	159 ↓
FS_V	4.33 ✓

Horizontal Force Analysis

Drag Force

A_{Tp} / A_W	Fr_L	C_{Di}	C_w	C_D*	F_D (lbf)
0.02	0.65	0.93	0.00	0.95	0

Passive Soil Pressure / Friction Force

Soil	K_P	F_P (lbf)	L_{Tf} (ft)	μ	F_F (lbf)
Bed	4.20	0	2.00	0.78	124
Bank	5.04	0	0.00	0.90	0
Total	-	0	2.00	-	124

Horizontal Force Balance

F_D (lbf)	0 →
F_P (lbf)	0
F_F (lbf)	124 ←
$F_{W,H}$ (lbf)	0
$F_{A,H}$ (lbf)	0
ΣF_H (lbf)	124 ←
FS_H	525.07 ✓

Moment Force Balance

Driving Moment Centroids / Resisting Moment Centroids

$c_{T,B}$ (ft)	c_L (ft)	c_D (ft)	$c_{T,W}$ (ft)	c_{soil} (ft)	$c_{F\&N}$ (ft)	c_P (ft)
5.1	0.0	0.0	5.1	0.0	0.0	0.0

*Distances are from the stem tip

Point of Rotation: Rootwad

Moment Force Balance

M_d (lbf)	133
M_r (lbf)	2,755
FS_M	20.65 ✓

Anchor Forces

Additional Soil Ballast

V_{Adry} (ft^3)	V_{Awet} (ft^3)	c_{Asoil} (ft)	$F_{A,Vsoil}$ (lbf)	$F_{A,HP}$ (lbf)
			0	0

Mechanical Anchors

Type	c_{Am} (ft)	Soils	F_{Am} (lbf)
			0
			0

Boulder Ballast

Position	D_r (ft)	c_{Ar} (ft)	$V_{r,dry}$ (ft^3)	$V_{r,wet}$ (ft^3)	W_r (lbf)	$F_{L,r}$ (lbf)	$F_{D,r}$ (lbf)	$F_{A,Vr}$ (lbf)	$F_{A,Hr}$ (lbf)
								0	0
								0	0
								0	0

Spreadsheet developed by
Michael Rafferty, P.E.

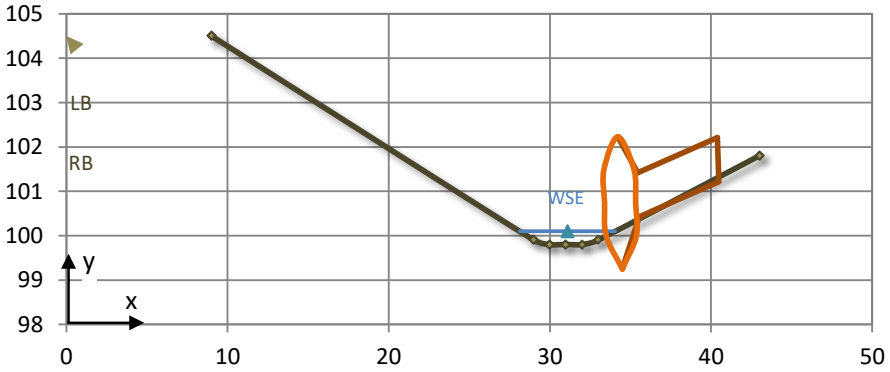
Single Log Stability Analysis Model Inputs

Site ID	Structure Type	Structure Position	Meander	Station	d_w (ft)	R_c/W_{BF}	u_{des} (ft/s)
LWM - Type A (2)	Rootwad	Right bank	Straight	1+09	0.30	166.67	3.28

Multi-Log Structures	Layer	Log ID
	Key Log	RW2

Channel Geometry Coordinates		
Proposed	x (ft)	y (ft)
Fldpln LB	9.00	104.50
Top LB	29.00	99.90
Toe LB	30.00	99.80
Thalweg	31.00	99.80
Toe RB	32.00	99.80
Top RB	33.00	99.90
Fldpln RB	43.00	101.80

Proposed Cross-Section and Structure Geometry (Looking D/S)



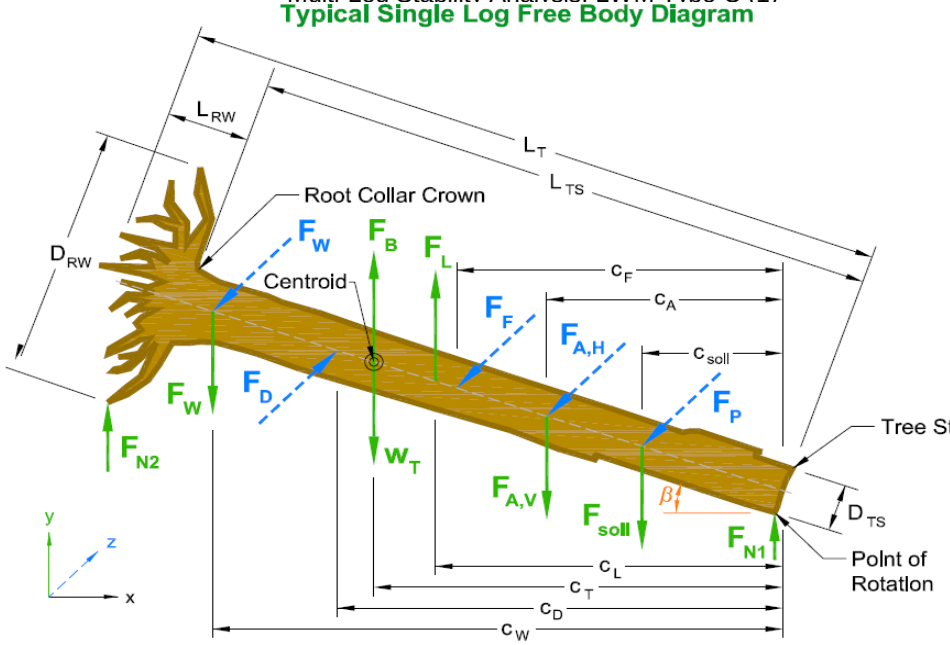
Wood Species	Rootwad	L_T (ft)	D_{TS} (ft)	L_{RW} (ft)	D_{RW} (ft)	γ_{Td} (lb/ft^3)	γ_{Tgr} (lb/ft^3)
Cedar, Western redcedar	Yes	8.0	1.00	1.50	3.00	22.4	27.0

Structure Geometry	θ (deg)	β (deg)	Define Fixed Point	x_T (ft)	y_T (ft)	$y_{T,min}$ (ft)	$y_{T,max}$ (ft)	A_{Tp} (ft^2)
	230.0	7.0	Rootwad: Bottom	34.50	99.25	99.25	102.23	0.53

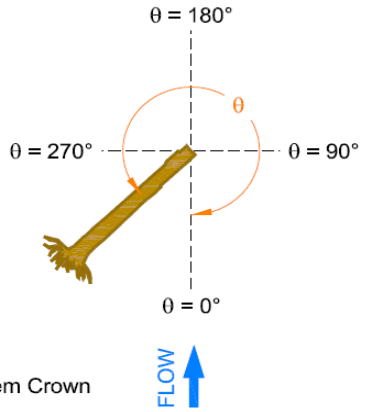
Soils	Material	γ_s (lb/ft^3)	γ'_s (lb/ft^3)	ϕ (deg)	Soil Class	$L_{T,em}$ (ft)	$d_{b,max}$ (ft)	$d_{b,avg}$ (ft)
Stream Bed	Coarse gravel	125.9	78.4	38.0	5	0.00	0.00	0.00
Bank	Fine sand, dense	114.0	71.0	42.0	6	0.00	0.00	0.00

Multi-Log Stability Analysis: LWM Type C (1)

Typical Single Log Free Body Diagram



Log Orientation (Plan View)



Vertical Force Analysis

Net Buoyancy Force

Wood	V_{TS} (ft^3)	V_{RW} (ft^3)	V_T (ft^3)	W_T (lbf)	F_B (lbf)
↑WSE	5.1	3.5	8.6	192	0
↓WS↑Thw	0.0	0.4	0.4	9	25
↓Thalweg	0.0	0.2	0.2	5	12
Total	5.1	4.1	9.2	206	37

Lift Force

C_{LT}	0.00
F_L (lbf)	0

Soil Ballast Force

Soil	V_{dry} (ft^3)	V_{sat} (ft^3)	V_{soil} (ft^3)	F_{soil} (lbf)
Bed	0.0	0.0	0.0	0
Bank	0.0	0.0	0.0	0
Total	0.0	0.0	0.0	0

Vertical Force Balance

F_B (lbf)	37
F_L (lbf)	0
W_T (lbf)	206
F_{soil} (lbf)	0
$F_{W,V}$ (lbf)	0
$F_{A,V}$ (lbf)	0
ΣF_V (lbf)	170
FS_V	5.62

Horizontal Force Analysis

Drag Force

A_{Tp} / A_W	Fr_L	C_{Di}	C_w	C_D*	F_D (lbf)
0.44	0.58	0.85	0.00	2.80	15

Passive Soil Pressure / Friction Force

Soil	K_P	F_P (lbf)	L_{Tf} (ft)	μ	F_F (lbf)
Bed	4.20	0	2.00	0.78	45
Bank	5.04	0	3.90	0.90	101
Total	-	0	5.90	-	146

Horizontal Force Balance

F_D (lbf)	15
F_P (lbf)	0
F_F (lbf)	146
$F_{W,H}$ (lbf)	0
$F_{A,H}$ (lbf)	0
ΣF_H (lbf)	131
FS_H	9.50

Moment Force Balance

Driving Moment Centroids / Resisting Moment Centroids

$c_{T,B}$ (ft)	c_L (ft)	c_D (ft)	$c_{T,W}$ (ft)	c_{soil} (ft)	$c_{F\&N}$ (ft)	c_P (ft)
5.1	0.0	8.0	5.1	0.0	1.9	0.0

*Distances are from the stem tip

Point of Rotation: Rootwad

Moment Force Balance

M_d (lbf)	104
M_r (lbf)	2,484
FS_M	23.84

Anchor Forces

Additional Soil Ballast

V_{Adry} (ft^3)	V_{Awet} (ft^3)	c_{Asoil} (ft)	$F_{A,Vsoil}$ (lbf)	$F_{A,HP}$ (lbf)
			0	0

Mechanical Anchors

Type	c_{Am} (ft)	Soils	F_{Am} (lbf)
			0
			0

Boulder Ballast

Position	D_r (ft)	c_{Ar} (ft)	$V_{r,dry}$ (ft^3)	$V_{r,wet}$ (ft^3)	W_r (lbf)	$F_{L,r}$ (lbf)	$F_{D,r}$ (lbf)	$F_{A,Vr}$ (lbf)	$F_{A,Hr}$ (lbf)
								0	0
								0	0
								0	0

Spreadsheet developed by
Michael Rafferty, P.E.

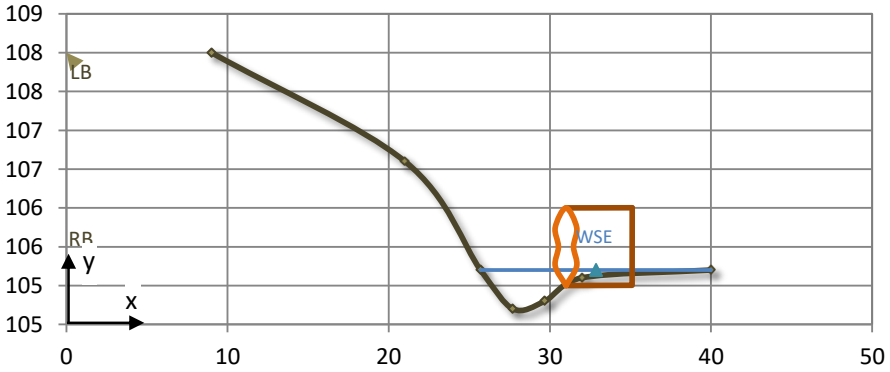
Single Log Stability Analysis Model Inputs

Site ID	Structure Type	Structure Position	Meander	Station	d_w (ft)	R_c/W_{BF}	u_{des} (ft/s)
LWM - Type B (1)	Flow Deflection	Right bank	Outside	0+04	0.50	2.14	3.29

Multi-Log Structures	Layer	Log ID
	Stacked	D1

Channel Geometry Coordinates		
Proposed	x (ft)	y (ft)
Fldpln LB	9.00	108.00
Top LB	21.00	106.60
Toe LB	25.70	105.20
Thalweg	27.70	104.70
Toe RB	29.70	104.80
Top RB	32.00	105.10
Fldpln RB	40.00	105.20

Proposed Cross-Section and Structure Geometry (Looking D/S)



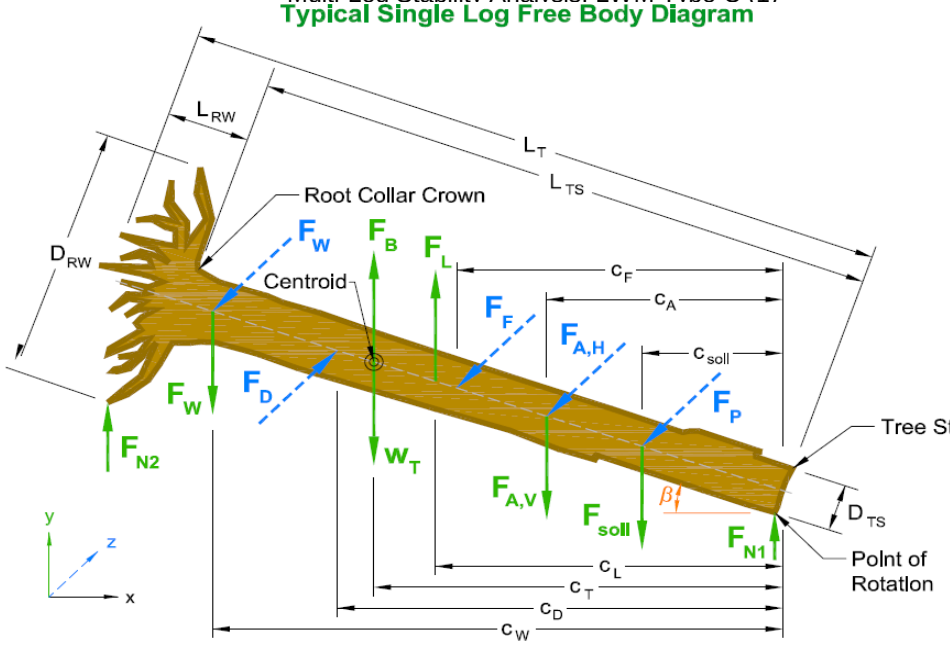
Wood Species	Rootwad	L_T (ft)	D_{TS} (ft)	L_{RW} (ft)	D_{RW} (ft)	γ_{Td} (lb/ft^3)	γ_{Tgr} (lb/ft^3)
Cedar, Western redcedar	No	12.0	1.00	-	-	22.4	27.0

Structure Geometry	θ (deg)	β (deg)	Define Fixed Point	x_T (ft)	y_T (ft)	$y_{T,min}$ (ft)	$y_{T,max}$ (ft)	A_{Tp} (ft^2)
	200.0	0.0	Root collar: Bottom	31.00	105.00	105.00	106.00	0.41

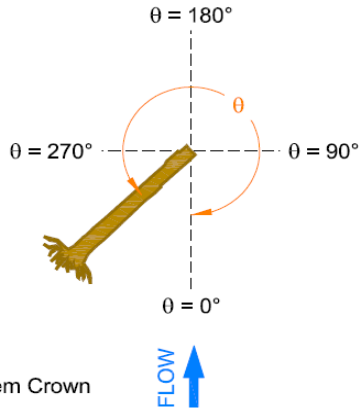
Soils	Material	γ_s (lb/ft^3)	γ'_s (lb/ft^3)	ϕ (deg)	Soil Class	$L_{T,em}$ (ft)	$d_{b,max}$ (ft)	$d_{b,avg}$ (ft)
Stream Bed	Coarse gravel	125.9	78.4	38.0	5	0.00	0.00	0.00
Bank	Fine sand, dense	114.0	71.0	42.0	6	0.00	0.00	0.00

Multi-Log Stability Analysis: LWM Type C (1)

Typical Single Log Free Body Diagram



Log Orientation (Plan View)



Vertical Force Analysis

Net Buoyancy Force

Wood	V_{TS} (ft^3)	V_{RW} (ft^3)	V_T (ft^3)	W_T (lbf)	F_B (lbf)
↑WSE	8.1	0.0	8.1	181	0
↓WS↑Thw	1.3	0.0	1.3	30	83
↓Thalweg	0.0	0.0	0.0	0	0
Total	9.4	0.0	9.4	211	83

Soil Ballast Force

Soil	V_{dry} (ft^3)	V_{sat} (ft^3)	V_{soil} (ft^3)	F_{soil} (lbf)
Bed	0.0	0.0	0.0	0
Bank	0.0	0.0	0.0	0
Total	0.0	0.0	0.0	0

Lift Force

C_{LT}	0.03
F_L (lbf)	0

Vertical Force Balance

F_B (lbf)	83 ↑
F_L (lbf)	0 ↑
W_T (lbf)	211 ↓
F_{soil} (lbf)	0
$F_{W,V}$ (lbf)	0
$F_{A,V}$ (lbf)	0
ΣF_V (lbf)	128 ↓
FS_V	2.53 ✓

Horizontal Force Analysis

Drag Force

A_{Tp} / A_W	Fr_L	C_{Di}	C_w	C_D*	F_D (lbf)
0.23	0.58	0.56	0.00	0.97	4

Passive Soil Pressure / Friction Force

Soil	K_P	F_P (lbf)	L_{Tf} (ft)	μ	F_F (lbf)
Bed	4.20	0	2.00	0.78	15
Bank	5.04	0	11.31	0.90	98
Total	-	0	13.31	-	113

Horizontal Force Balance

F_D (lbf)	4 →
F_P (lbf)	0
F_F (lbf)	113 ←
$F_{W,H}$ (lbf)	0
$F_{A,H}$ (lbf)	0
ΣF_H (lbf)	108 ←
FS_H	27.01 ✓

Moment Force Balance

Driving Moment Centroids / Resisting Moment Centroids

$c_{T,B}$ (ft)	c_L (ft)	c_D (ft)	$c_{T,W}$ (ft)	c_{soil} (ft)	$c_{F\&N}$ (ft)	c_P (ft)
6.0	11.7	6.0	6.0	0.0	5.6	0.0

*Distances are from the stem tip

Point of Rotation: Root Collar

Moment Force Balance

M_d (lbf)	524 ↻
M_r (lbf)	2,792 ↺
FS_M	5.33 ✓

Anchor Forces

Additional Soil Ballast

V_{Adry} (ft^3)	V_{Awet} (ft^3)	c_{Asoil} (ft)	$F_{A,Vsoil}$ (lbf)	$F_{A,HP}$ (lbf)
			0	0

Mechanical Anchors

Type	c_{Am} (ft)	Soils	F_{Am} (lbf)
			0
			0

Boulder Ballast

Position	D_r (ft)	c_{Ar} (ft)	$V_{r,dry}$ (ft^3)	$V_{r,wet}$ (ft^3)	W_r (lbf)	$F_{L,r}$ (lbf)	$F_{D,r}$ (lbf)	$F_{A,Vr}$ (lbf)	$F_{A,Hr}$ (lbf)
								0	0
								0	0
								0	0

Spreadsheet developed by
Michael Rafferty, P.E.

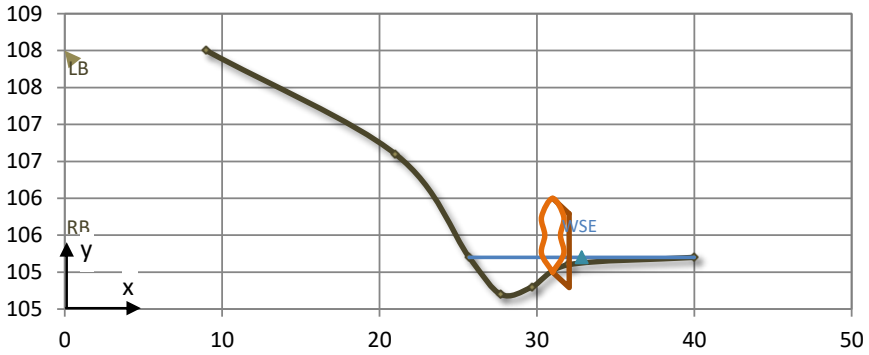
Single Log Stability Analysis Model Inputs

Site ID	Structure Type	Structure Position	Meander	Station	d_w (ft)	R_c/W_{BF}	u_{des} (ft/s)
LWM - Type B (1)	Flow Deflection	Right bank	Outside	0+04	0.50	2.14	3.29

Multi-Log Structures	Layer	Log ID
	Stacked	D2

Channel Geometry Coordinates		
Proposed	x (ft)	y (ft)
Fldpln LB	9.00	108.00
Top LB	21.00	106.60
Toe LB	25.70	105.20
Thalweg	27.70	104.70
Toe RB	29.70	104.80
Top RB	32.00	105.10
Fldpln RB	40.00	105.20

Proposed Cross-Section and Structure Geometry (Looking D/S)



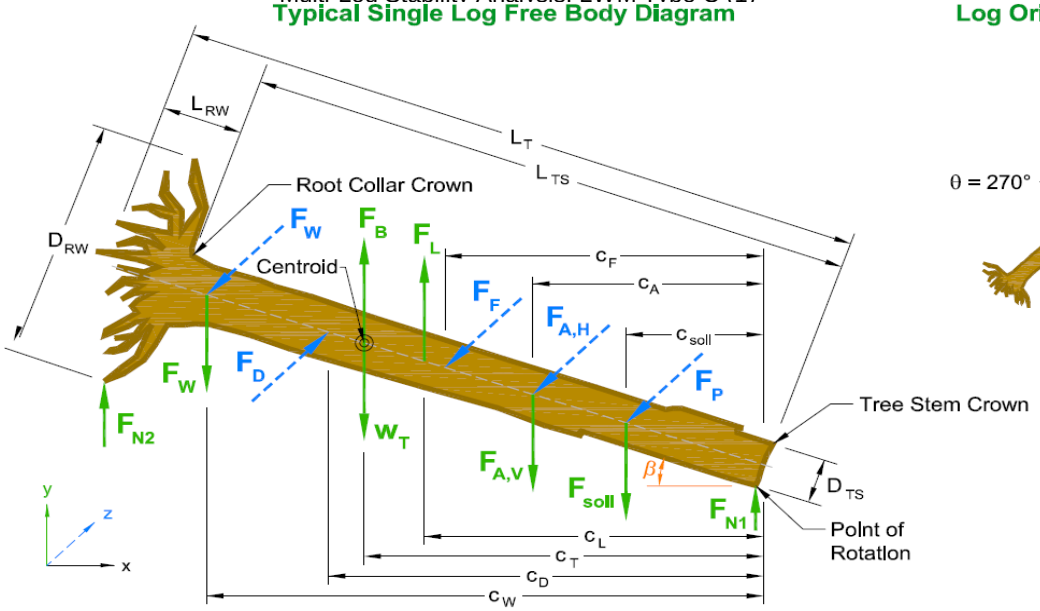
Wood Species	Rootwad	L_T (ft)	D_{TS} (ft)	L_{RW} (ft)	D_{RW} (ft)	γ_{Td} (lb/ft^3)	γ_{Tgr} (lb/ft^3)
Cedar, Western redcedar	No	12.0	1.00	-	-	22.4	27.0

Structure Geometry	θ (deg)	β (deg)	Define Fixed Point	x_T (ft)	y_T (ft)	$y_{T,min}$ (ft)	$y_{T,max}$ (ft)	A_{Tp} (ft^2)
	185.0	-1.0	Root collar: Bottom	31.00	105.00	104.79	106.00	0.17

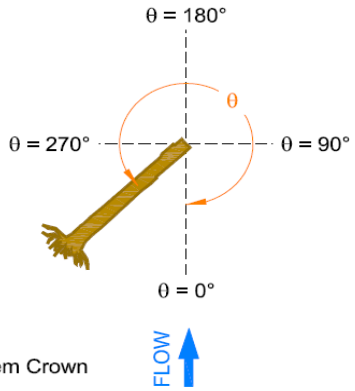
Soils	Material	γ_s (lb/ft^3)	γ'_s (lb/ft^3)	ϕ (deg)	Soil Class	$L_{T,em}$ (ft)	$d_{b,max}$ (ft)	$d_{b,avg}$ (ft)
Stream Bed	Coarse gravel	125.9	78.4	38.0	5	0.00	0.00	0.00
Bank	Fine sand, dense	114.0	71.0	42.0	6	0.00	0.00	0.00

Multi-Log Stability Analysis: LWM Type C (1)

Typical Single Log Free Body Diagram



Log Orientation (Plan View)



Vertical Force Analysis

Net Buoyancy Force

Wood	V_{TS} (ft^3)	V_{RW} (ft^3)	V_T (ft^3)	W_T (lbf)	F_B (lbf)
↑WSE	7.0	0.0	7.0	156	0
↓WS↑Thw	2.4	0.0	2.4	54	152
↓Thalweg	0.0	0.0	0.0	0	0
Total	9.4	0.0	9.4	211	152

Lift Force

C_{LT}	0.04
F_L (lbf)	0

Soil Ballast Force

Soil	V_{dry} (ft^3)	V_{sat} (ft^3)	V_{soil} (ft^3)	F_{soil} (lbf)
Bed	0.0	0.0	0.0	0
Bank	0.0	0.0	0.0	0
Total	0.0	0.0	0.0	0

Vertical Force Balance

F_B (lbf)	152 ↑
F_L (lbf)	0 ↑
W_T (lbf)	211 ↓
F_{soil} (lbf)	0
$F_{W,V}$ (lbf)	65 ↓
$F_{A,V}$ (lbf)	0
ΣF_V (lbf)	124 ↓
FS_V	1.82 ✓

Horizontal Force Analysis

Drag Force

A_{Tp} / A_W	Fr_L	C_{Di}	C_w	C_D*	F_D (lbf)
0.10	0.58	0.89	0.00	1.09	2

Passive Soil Pressure / Friction Force

Soil	K_P	F_P (lbf)	L_{Tf} (ft)	μ	F_F (lbf)
Bed	4.20	0	2.00	0.78	15
Bank	5.04	0	10.95	0.90	95
Total	-	0	12.95	-	110

Horizontal Force Balance

F_D (lbf)	2 →
F_P (lbf)	0
F_F (lbf)	110 ←
$F_{W,H}$ (lbf)	0
$F_{A,H}$ (lbf)	0
ΣF_H (lbf)	108 ←
FS_H	57.08 ✓

Moment Force Balance

Driving Moment Centroids / Resisting Moment Centroids

$c_{T,B}$ (ft)	c_L (ft)	c_D (ft)	$c_{T,W}$ (ft)	c_{soil} (ft)	$c_{F\&N}$ (ft)	c_P (ft)
6.0	11.5	6.0	6.0	0.0	5.5	0.0

*Distances are from the stem tip

Point of Rotation: Root Collar

Moment Force Balance

M_d (lbf)	921 ↻
M_r (lbf)	3,249 ↺
FS_M	3.53 ✓

Anchor Forces

Additional Soil Ballast

V_{Adry} (ft^3)	V_{Awet} (ft^3)	c_{Asoil} (ft)	$F_{A,Vsoil}$ (lbf)	$F_{A,HP}$ (lbf)
			0	0

Mechanical Anchors

Type	c_{Am} (ft)	Soils	F_{Am} (lbf)
			0
			0

Boulder Ballast

Position	D_r (ft)	c_{Ar} (ft)	$V_{r,dry}$ (ft^3)	$V_{r,wet}$ (ft^3)	W_r (lbf)	$F_{L,r}$ (lbf)	$F_{D,r}$ (lbf)	$F_{A,Vr}$ (lbf)	$F_{A,Hr}$ (lbf)
								0	0
								0	0
								0	0

Interaction Forces with Adjacent Logs

Applied Forces from other Logs

Log ID	Position	Link	c_{WI} (ft)	$F_{W,V}$ (lbf)	$F_{W,H}$ (lbf)	$F_{W,V}$ (lbf)	$F_{W,H}$ (lbf)
D1	Above	Gravity	5.0	-65	-106	65 ↓	0
						0	0
						0	0
						0	0

Building X

Spreadsheet developed by
Michael Rafferty, P.E.

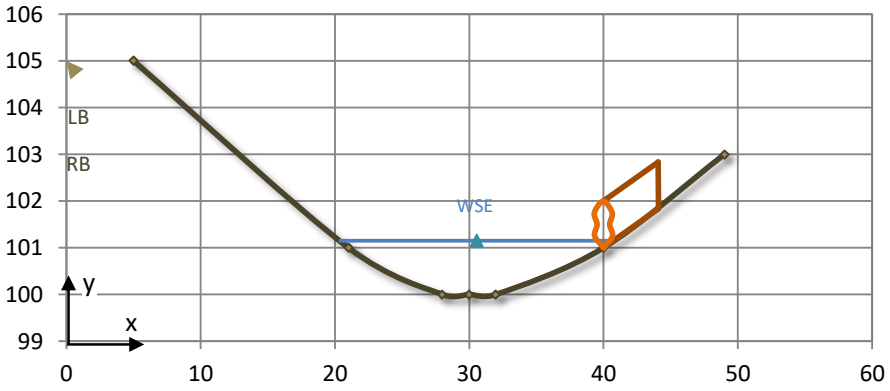
Single Log Stability Analysis Model Inputs

Site ID	Structure Type	Structure Position	Meander	Station	d_w (ft)	R_c/W_{BF}	u_{des} (ft/s)
LWM - Type B (2)	Flow Deflection	Right bank	Straight	0+68	1.15	33.33	1.74

Multi-Log Structures	Layer	Log ID
	Stacked	D1

Channel Geometry Coordinates		
Proposed	x (ft)	y (ft)
Fldpln LB	5.00	105.00
Top LB	21.00	101.00
Toe LB	28.00	100.00
Thalweg	30.00	100.00
Toe RB	32.00	100.00
Top RB	40.00	101.00
Fldpln RB	49.00	103.00

Proposed Cross-Section and Structure Geometry (Looking D/S)



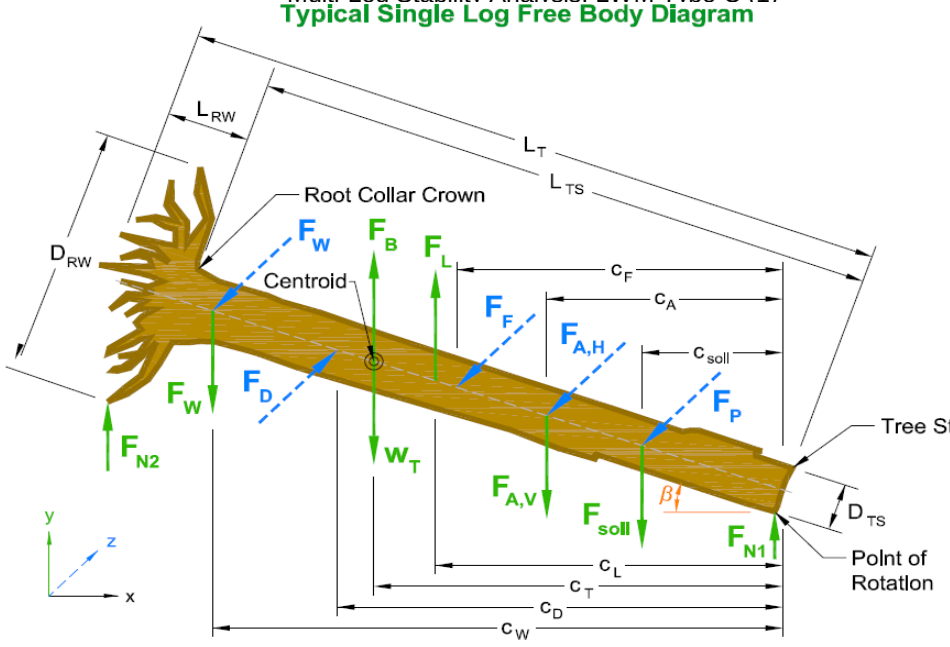
Wood Species	Rootwad	L_T (ft)	D_{TS} (ft)	L_{RW} (ft)	D_{RW} (ft)	γ_{Td} (lb/ft^3)	γ_{Tgr} (lb/ft^3)
Cedar, Western redcedar	No	12.0	1.00	-	-	22.4	27.0

Structure Geometry	θ (deg)	β (deg)	Define Fixed Point	x_T (ft)	y_T (ft)	$y_{T,min}$ (ft)	$y_{T,max}$ (ft)	A_{Tp} (ft^2)
	200.0	4.0	Root collar: Bottom	40.00	101.00	101.00	102.83	0.06

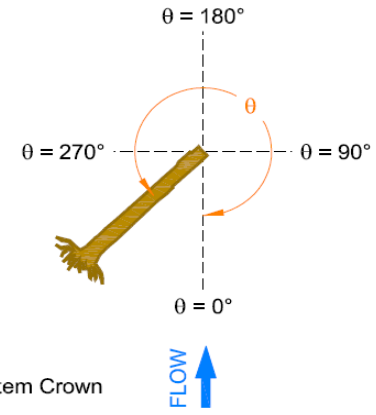
Soils	Material	γ_s (lb/ft^3)	γ'_s (lb/ft^3)	ϕ (deg)	Soil Class	$L_{T,em}$ (ft)	$d_{b,max}$ (ft)	$d_{b,avg}$ (ft)
Stream Bed	Coarse gravel	125.9	78.4	38.0	5	0.00	0.00	0.00
Bank	Fine sand, dense	114.0	71.0	42.0	6	0.00	0.00	0.00

Multi-Log Stability Analysis: LWM Type C (1)

Typical Single Log Free Body Diagram



Log Orientation (Plan View)



Vertical Force Analysis

Net Buoyancy Force

Wood	V_{TS} (ft^3)	V_{RW} (ft^3)	V_T (ft^3)	W_T (lbf)	F_B (lbf)
↑WSE	9.4	0.0	9.4	209	0
↓WS↑Thw	0.1	0.0	0.1	1	4
↓Thalweg	0.0	0.0	0.0	0	0
Total	9.4	0.0	9.4	211	4

Lift Force

C_{LT}	0.19
F_L (lbf)	0

Soil Ballast Force

Soil	V_{dry} (ft^3)	V_{sat} (ft^3)	V_{soil} (ft^3)	F_{soil} (lbf)
Bed	0.0	0.0	0.0	0
Bank	0.0	0.0	0.0	0
Total	0.0	0.0	0.0	0

Vertical Force Balance

F_B (lbf)	4 ↑
F_L (lbf)	0 ↑
W_T (lbf)	211 ↓
F_{soil} (lbf)	0
$F_{W,V}$ (lbf)	0
$F_{A,V}$ (lbf)	0
ΣF_V (lbf)	207 ↓
FS_V	51.79 ✓

Horizontal Force Analysis

Drag Force

A_{Tp} / A_W	Fr_L	C_{Di}	C_w	C_D*	F_D (lbf)
0.00	0.31	0.56	0.00	0.56	0

Passive Soil Pressure / Friction Force

Soil	K_P	F_P (lbf)	L_{Tf} (ft)	μ	F_F (lbf)
Bed	4.20	0	2.00	0.78	25
Bank	5.04	0	11.13	0.90	158
Total	-	0	13.13	-	182

Horizontal Force Balance

F_D (lbf)	0 →
F_P (lbf)	0
F_F (lbf)	182 ←
$F_{W,H}$ (lbf)	0
$F_{A,H}$ (lbf)	0
ΣF_H (lbf)	182 ←
FS_H	1,761.60 ✓

Moment Force Balance

Driving Moment Centroids / Resisting Moment Centroids

$c_{T,B}$ (ft)	c_L (ft)	c_D (ft)	$c_{T,W}$ (ft)	c_{soil} (ft)	$c_{F\&N}$ (ft)	c_P (ft)
6.0	11.6	11.0	6.0	0.0	5.6	0.0

*Distances are from the stem tip

Point of Rotation: Root Collar

Moment Force Balance

M_d (lbf)	24 ↻
M_r (lbf)	3,765 ↺
FS_M	155.09 ✓

Anchor Forces

Additional Soil Ballast

V_{Adry} (ft^3)	V_{Awet} (ft^3)	c_{Asoil} (ft)	$F_{A,Vsoil}$ (lbf)	$F_{A,HP}$ (lbf)
			0	0

Mechanical Anchors

Type	c_{Am} (ft)	Soils	F_{Am} (lbf)
			0
			0

Boulder Ballast

Position	D_r (ft)	c_{Ar} (ft)	$V_{r,dry}$ (ft^3)	$V_{r,wet}$ (ft^3)	W_r (lbf)	$F_{L,r}$ (lbf)	$F_{D,r}$ (lbf)	$F_{A,Vr}$ (lbf)	$F_{A,Hr}$ (lbf)
								0	0
								0	0
								0	0

Spreadsheet developed by
Michael Rafferty, P.E.

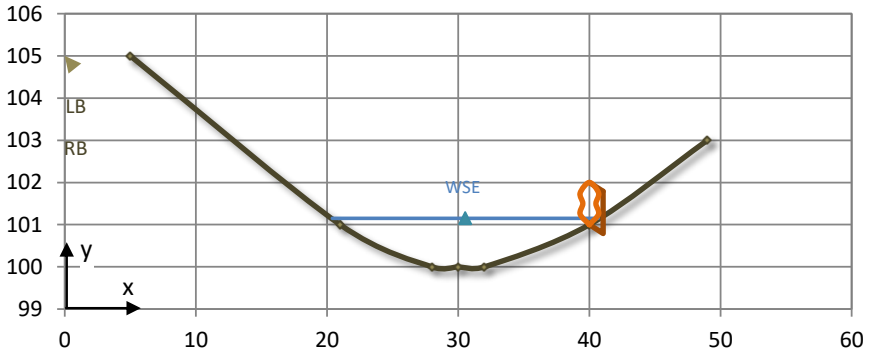
Single Log Stability Analysis Model Inputs

Site ID	Structure Type	Structure Position	Meander	Station	d_w (ft)	R_c/W_{BF}	u_{des} (ft/s)
LWM - Type B (2)	Flow Deflection	Right bank	Straight	0+68	1.15	33.33	1.74

Multi-Log Structures	Layer	Log ID
	Stacked	D2

Channel Geometry Coordinates		
Proposed	x (ft)	y (ft)
Fldpln LB	5.00	105.00
Top LB	21.00	101.00
Toe LB	28.00	100.00
Thalweg	30.00	100.00
Toe RB	32.00	100.00
Top RB	40.00	101.00
Fldpln RB	49.00	103.00

Proposed Cross-Section and Structure Geometry (Looking D/S)



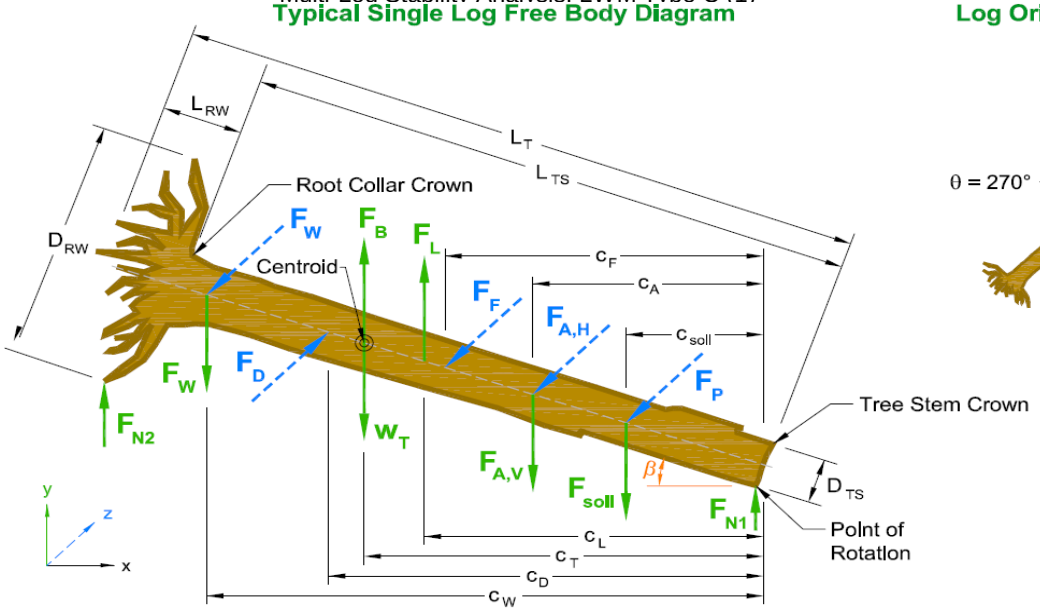
Wood Species	Rootwad	L_T (ft)	D_{TS} (ft)	L_{RW} (ft)	D_{RW} (ft)	γ_{Td} (lb/ft^3)	γ_{Tgr} (lb/ft^3)
Cedar, Western redcedar	No	12.0	1.00	-	-	22.4	27.0

Structure Geometry	θ (deg)	β (deg)	Define Fixed Point	x_T (ft)	y_T (ft)	$y_{T,min}$ (ft)	$y_{T,max}$ (ft)	A_{Tp} (ft^2)
	185.0	-1.0	Root collar: Bottom	40.00	101.00	100.79	102.00	0.05

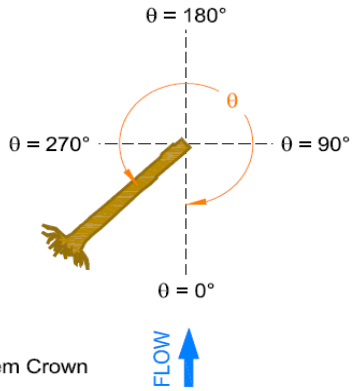
Soils	Material	γ_s (lb/ft^3)	γ'_s (lb/ft^3)	ϕ (deg)	Soil Class	$L_{T,em}$ (ft)	$d_{b,max}$ (ft)	$d_{b,avg}$ (ft)
Stream Bed	Coarse gravel	125.9	78.4	38.0	5	0.00	0.00	0.00
Bank	Fine sand, dense	114.0	71.0	42.0	6	0.00	0.00	0.00

Multi-Log Stability Analysis: LWM Type C (1)

Typical Single Log Free Body Diagram



Log Orientation (Plan View)



Vertical Force Analysis

Net Buoyancy Force

Wood	V_{TS} (ft^3)	V_{RW} (ft^3)	V_T (ft^3)	W_T (lbf)	F_B (lbf)
↑WSE	7.5	0.0	7.5	168	0
↓WS↑Thw	1.9	0.0	1.9	42	118
↓Thalweg	0.0	0.0	0.0	0	0
Total	9.4	0.0	9.4	211	118

Soil Ballast Force

Soil	V_{dry} (ft^3)	V_{sat} (ft^3)	V_{soil} (ft^3)	F_{soil} (lbf)
Bed	0.0	0.0	0.0	0
Bank	0.0	0.0	0.0	0
Total	0.0	0.0	0.0	0

Lift Force

C_{LT}	0.00
F_L (lbf)	0

Vertical Force Balance

F_B (lbf)	118 ↑
F_L (lbf)	0
W_T (lbf)	211 ↓
F_{soil} (lbf)	0
$F_{W,V}$ (lbf)	65 ↓
$F_{A,V}$ (lbf)	0
ΣF_V (lbf)	158 ↓
FS_V	2.34 ✓

Horizontal Force Analysis

Drag Force

A_{Tp} / A_W	Fr_L	C_{Di}	C_w	C_D*	F_D (lbf)
0.00	0.31	0.89	0.00	0.89	0

Passive Soil Pressure / Friction Force

Soil	K_P	F_P (lbf)	L_{Tf} (ft)	μ	F_F (lbf)
Bed	4.20	0	2.00	0.78	18
Bank	5.04	0	12.00	0.90	122
Total	-	0	14.00	-	139

Horizontal Force Balance

F_D (lbf)	0 →
F_P (lbf)	0
F_F (lbf)	139 ←
$F_{W,H}$ (lbf)	0
$F_{A,H}$ (lbf)	0
ΣF_H (lbf)	139 ←
FS_H	1,080.28 ✓

Moment Force Balance

Driving Moment Centroids / Resisting Moment Centroids

$c_{T,B}$ (ft)	c_L (ft)	c_D (ft)	$c_{T,W}$ (ft)	c_{soil} (ft)	$c_{F\&N}$ (ft)	c_P (ft)
6.0	0.0	6.0	6.0	0.0	6.0	0.0

*Distances are from the stem tip

Point of Rotation: Root Collar

Moment Force Balance

M_d (lbf)	709
M_r (lbf)	3,504
FS_M	4.94 ✓

Anchor Forces

Additional Soil Ballast

V_{Adry} (ft^3)	V_{Awet} (ft^3)	c_{Asoil} (ft)	$F_{A,Vsoil}$ (lbf)	$F_{A,HP}$ (lbf)
			0	0

Mechanical Anchors

Type	c_{Am} (ft)	Soils	F_{Am} (lbf)
			0
			0

Boulder Ballast

Position	D_r (ft)	c_{Ar} (ft)	$V_{r,dry}$ (ft^3)	$V_{r,wet}$ (ft^3)	W_r (lbf)	$F_{L,r}$ (lbf)	$F_{D,r}$ (lbf)	$F_{A,Vr}$ (lbf)	$F_{A,Hr}$ (lbf)
								0	0
								0	0
								0	0

Interaction Forces with Adjacent Logs

Applied Forces from other Logs

Log ID	Position	Link	c_{WI} (ft)	$F_{W,V}$ (lbf)	$F_{W,H}$ (lbf)	$F_{W,V}$ (lbf)	$F_{W,H}$ (lbf)
D1	Above	Gravity	5.0	-65	-106	65 ↓	0
						0	0
						0	0
						0	0

Building X

Spreadsheet developed by
Michael Rafferty, P.E.

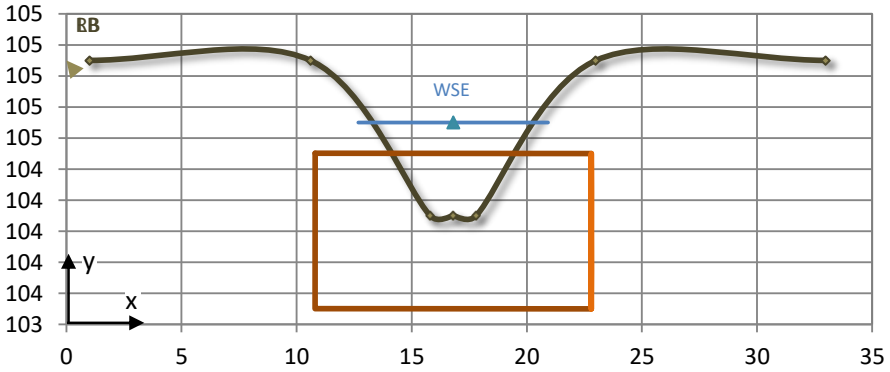
Single Log Stability Analysis Model Inputs

Site ID	Structure Type	Structure Position	Meander	Station	d_w (ft)	R_c/W_{BF}	u_{des} (ft/s)
LWM - Type C (1)	Log Weir	Full span	Straight	0+40	0.60	200.00	2.15

Multi-Log Structures	Layer	Log ID
	Key Log	W1

Channel Geometry Coordinates		
Proposed	x (ft)	y (ft)
Fldpln LB	1.00	105.10
Top LB	10.60	105.10
Toe LB	15.80	104.10
Thalweg	16.80	104.10
Toe RB	17.80	104.10
Top RB	23.00	105.10
Fldpln RB	33.00	105.10

Proposed Cross-Section and Structure Geometry (Looking D/S)



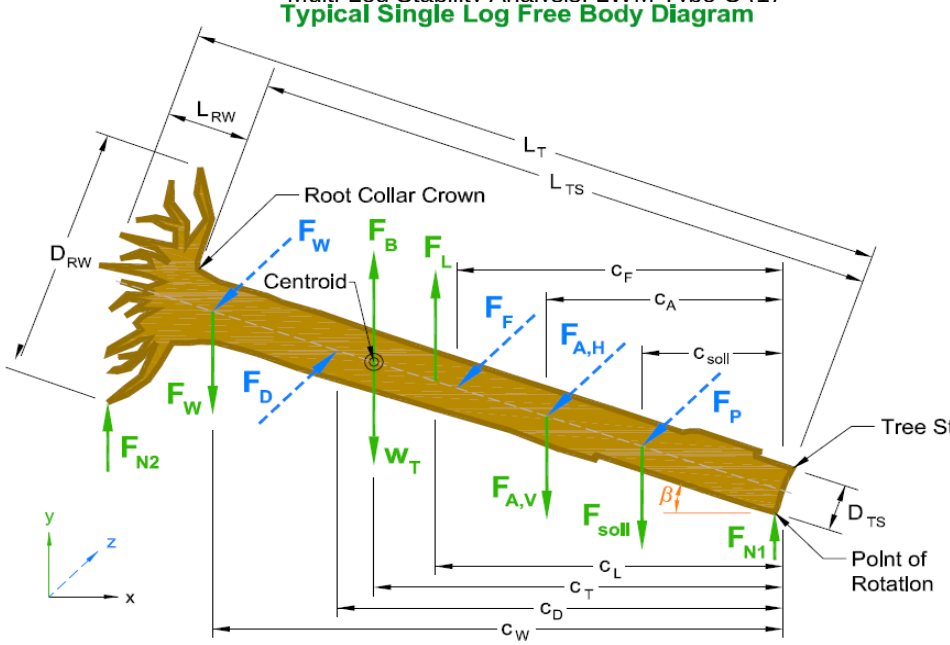
Wood Species	Rootwad	L_T (ft)	D_{TS} (ft)	L_{RW} (ft)	D_{RW} (ft)	γ_{Td} (lb/ft^3)	γ_{Tgr} (lb/ft^3)
Cedar, Western redcedar	No	12.0	1.00	-	-	22.4	27.0

Structure Geometry	θ (deg)	β (deg)	Define Fixed Point	x_T (ft)	y_T (ft)	$y_{T,min}$ (ft)	$y_{T,max}$ (ft)	A_{Tp} (ft^2)
	89.0	0.0	Root collar: Crown	22.80	104.50	103.50	104.50	1.58

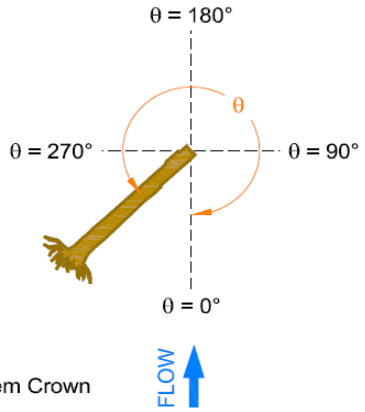
Soils	Material	γ_s (lb/ft^3)	γ'_s (lb/ft^3)	ϕ (deg)	Soil Class	$L_{T,em}$ (ft)	$d_{b,max}$ (ft)	$d_{b,avg}$ (ft)
Stream Bed	Coarse gravel	125.9	78.4	38.0	5	0.00	0.00	0.00
Bank	Fine sand, dense	114.0	71.0	42.0	6	5.83	0.56	0.28

Multi-Log Stability Analysis: LWM Type C (1)

Typical Single Log Free Body Diagram



Log Orientation (Plan View)



Vertical Force Analysis

Net Buoyancy Force

Wood	V_{TS} (ft^3)	V_{RW} (ft^3)	V_T (ft^3)	W_T (lbf)	F_B (lbf)
↑WSE	0.0	0.0	0.0	0	0
↓WS↑Thw	3.5	0.0	3.5	79	220
↓Thalweg	5.9	0.0	5.9	159	368
Total	9.4	0.0	9.4	238	588

Lift Force

C_{LT}	0.00
F_L (lbf)	0

Soil Ballast Force

Soil	V_{dry} (ft^3)	V_{sat} (ft^3)	V_{soil} (ft^3)	F_{soil} (lbf)
Bed	0.0	0.0	0.0	0
Bank	0.7	1.0	1.6	145
Total	0.7	1.0	1.6	145

Vertical Force Balance

F_B (lbf)	588 ↑
F_L (lbf)	0
W_T (lbf)	238 ↓
F_{soil} (lbf)	145 ↓
$F_{W,V}$ (lbf)	0
$F_{A,V}$ (lbf)	0
ΣF_V (lbf)	205 ↑
FS_V	0.65 ✗

Horizontal Force Analysis

Drag Force

A_{Tp} / A_W	Fr_L	C_{Di}	C_w	C_D*	F_D (lbf)
0.75	0.38	0.93	0.43	23.85	169

Passive Soil Pressure / Friction Force

Soil	K_P	F_P (lbf)	L_{Tf} (ft)	μ	F_F (lbf)
Bed	4.20	0	3.98	0.78	0
Bank	5.04	366	10.02	0.90	0
Total	-	366	14.00	-	0

Horizontal Force Balance

F_D (lbf)	169 →
F_P (lbf)	366 ←
F_F (lbf)	0
$F_{W,H}$ (lbf)	0
$F_{A,H}$ (lbf)	0
ΣF_H (lbf)	197 ←
FS_H	2.17 ✓

Moment Force Balance

Driving Moment Centroids / Resisting Moment Centroids

$c_{T,B}$ (ft)	c_L (ft)	c_D (ft)	$c_{T,W}$ (ft)	c_{soil} (ft)	$c_{F\&N}$ (ft)	c_P (ft)
6.0	0.0	6.0	6.0	6.0	0.0	6.0

*Distances are from the stem tip

Point of Rotation: Root Collar

Moment Force Balance

M_d (lbf)	4,541
M_r (lbf)	4,496
FS_M	0.99 ✗

Anchor Forces

Additional Soil Ballast

V_{Adry} (ft^3)	V_{Awet} (ft^3)	c_{Asoil} (ft)	$F_{A,Vsoil}$ (lbf)	$F_{A,HP}$ (lbf)
			0	0

Mechanical Anchors

Type	c_{Am} (ft)	Soils	F_{Am} (lbf)
			0
			0

Boulder Ballast

Position	D_r (ft)	c_{Ar} (ft)	$V_{r,dry}$ (ft^3)	$V_{r,wet}$ (ft^3)	W_r (lbf)	$F_{L,r}$ (lbf)	$F_{D,r}$ (lbf)	$F_{A,Vr}$ (lbf)	$F_{A,Hr}$ (lbf)
								0	0
								0	0
								0	0

Building X

Spreadsheet developed by
Michael Rafferty, P.E.

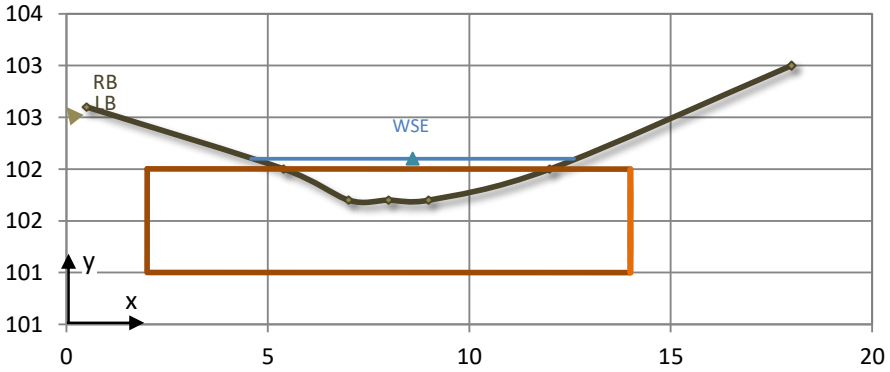
Single Log Stability Analysis Model Inputs

Site ID	Structure Type	Structure Position	Meander	Station	d_w (ft)	R_c/W_{BF}	u_{des} (ft/s)
LWM - Type C (2)	Log Weir	Full span	Straight	0+83	0.40	125.00	1.85

Multi-Log Structures	Layer	Log ID
	Key Log	W2

Channel Geometry Coordinates		
Proposed	x (ft)	y (ft)
Fldpln LB	0.50	102.60
Top LB	5.40	102.00
Toe LB	7.00	101.70
Thalweg	8.00	101.70
Toe RB	9.00	101.70
Top RB	12.00	102.00
Fldpln RB	18.00	103.00

Proposed Cross-Section and Structure Geometry (Looking D/S)



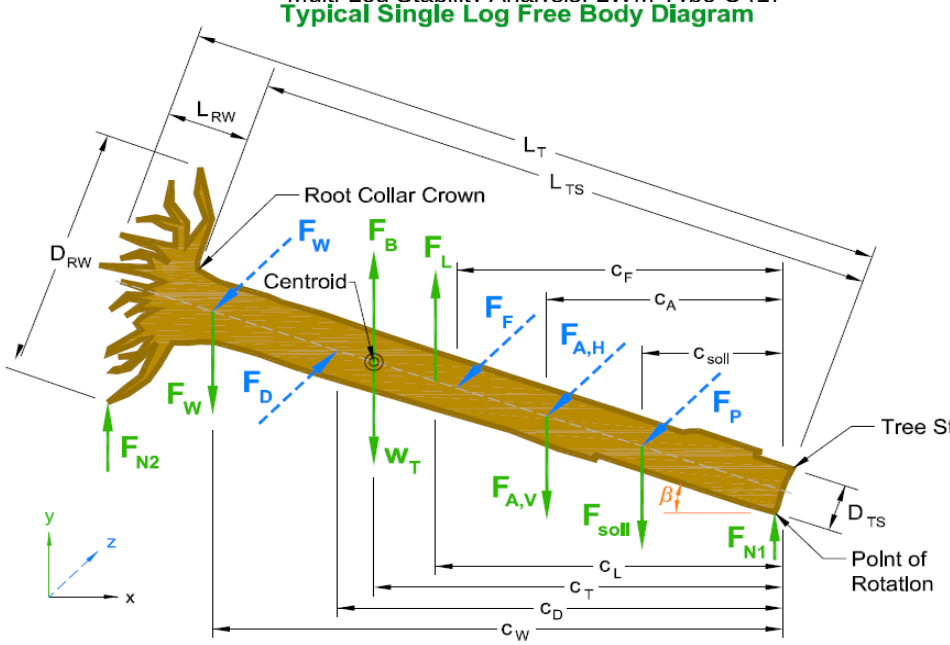
Wood Species	Rootwad	L_T (ft)	D_{TS} (ft)	L_{RW} (ft)	D_{RW} (ft)	γ_{Td} (lb/ft^3)	γ_{Tgr} (lb/ft^3)
Cedar, Western redcedar	No	12.0	1.00	-	-	22.4	27.0

Structure Geometry	θ (deg)	β (deg)	Define Fixed Point	x_T (ft)	y_T (ft)	$y_{T,min}$ (ft)	$y_{T,max}$ (ft)	A_{Tp} (ft^2)
	89.0	0.0	Root collar: Crown	14.00	102.00	101.00	102.00	1.24

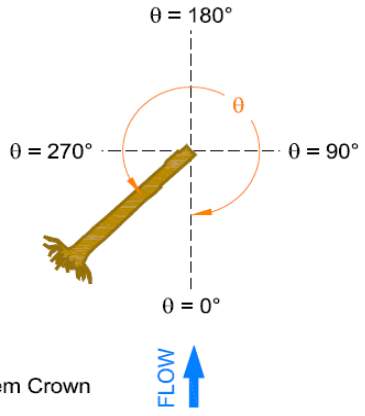
Soils	Material	γ_s (lb/ft^3)	γ'_s (lb/ft^3)	ϕ (deg)	Soil Class	$L_{T,em}$ (ft)	$d_{b,max}$ (ft)	$d_{b,avg}$ (ft)
Stream Bed	Coarse gravel	125.9	78.4	38.0	5	0.00	0.00	0.00
Bank	Fine sand, dense	114.0	71.0	42.0	6	5.38	0.41	0.19

Multi-Log Stability Analysis: LWM Type C (1)

Typical Single Log Free Body Diagram



Log Orientation (Plan View)



Vertical Force Analysis

Net Buoyancy Force

Wood	V_{TS} (ft^3)	V_{RW} (ft^3)	V_T (ft^3)	W_T (lbf)	F_B (lbf)
↑WSE	0.0	0.0	0.0	0	0
↓WS↑Thw	2.4	0.0	2.4	53	149
↓Thalweg	7.0	0.0	7.0	190	439
Total	9.4	0.0	9.4	243	588

Soil Ballast Force

Soil	V_{dry} (ft^3)	V_{sat} (ft^3)	V_{soil} (ft^3)	F_{soil} (lbf)
Bed	0.0	0.0	0.0	0
Bank	0.6	0.5	1.0	98
Total	0.6	0.5	1.0	98

Lift Force

C_{LT}	0.00
F_L (lbf)	0

Vertical Force Balance

F_B (lbf)	588 ↑
F_L (lbf)	0
W_T (lbf)	243 ↓
F_{soil} (lbf)	98 ↓
$F_{W,V}$ (lbf)	0
$F_{A,V}$ (lbf)	0
ΣF_V (lbf)	247 ↑
FS_V	0.58 ✗

Horizontal Force Analysis

Drag Force

A_{Tp} / A_W	Fr_L	C_{Di}	C_w	C_D*	F_D (lbf)
0.62	0.33	0.93	0.43	9.83	40

Passive Soil Pressure / Friction Force

Soil	K_P	F_P (lbf)	L_{Tf} (ft)	μ	F_F (lbf)
Bed	4.20	0	3.98	0.78	0
Bank	5.04	247	10.02	0.90	0
Total	-	247	14.00	-	0

Horizontal Force Balance

F_D (lbf)	40 →
F_P (lbf)	247 ←
F_F (lbf)	0
$F_{W,H}$ (lbf)	0
$F_{A,H}$ (lbf)	0
ΣF_H (lbf)	207 ←
FS_H	6.13 ✓

Moment Force Balance

Driving Moment Centroids / Resisting Moment Centroids

$c_{T,B}$ (ft)	c_L (ft)	c_D (ft)	$c_{T,W}$ (ft)	c_{soil} (ft)	$c_{F\&N}$ (ft)	c_P (ft)
6.0	0.0	6.7	6.0	5.2	0.0	6.0

*Distances are from the stem tip

Point of Rotation: Root Collar

Moment Force Balance

M_d (lbf)	3,743
M_r (lbf)	3,613
FS_M	0.97 ✗

Anchor Forces

Additional Soil Ballast

V_{Adry} (ft^3)	V_{Awet} (ft^3)	c_{Asoil} (ft)	$F_{A,Vsoil}$ (lbf)	$F_{A,HP}$ (lbf)
			0	0

Mechanical Anchors

Type	c_{Am} (ft)	Soils	F_{Am} (lbf)
			0
			0

Boulder Ballast

Position	D_r (ft)	c_{Ar} (ft)	$V_{r,dry}$ (ft^3)	$V_{r,wet}$ (ft^3)	W_r (lbf)	$F_{L,r}$ (lbf)	$F_{D,r}$ (lbf)	$F_{A,Vr}$ (lbf)	$F_{A,Hr}$ (lbf)
								0	0
								0	0
								0	0

Spreadsheet developed by
Michael Rafferty, P.E.

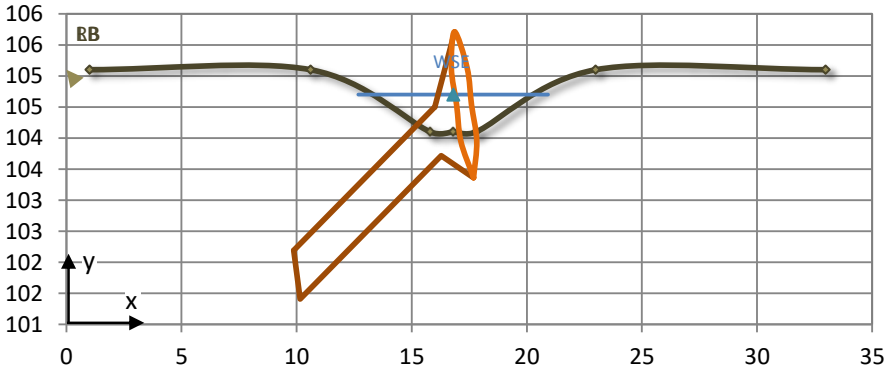
Single Log Stability Analysis Model Inputs

Site ID	Structure Type	Structure Position	Meander	Station	d_w (ft)	R_c/W_{BF}	u_{des} (ft/s)
LWM - Type C (1)	Rootwad	Left bank	Straight	0+40	0.60	200.00	2.15

Multi-Log Structures	Layer	Log ID
	Footer	W1

Channel Geometry Coordinates		
Proposed	x (ft)	y (ft)
Fldpln LB	1.00	105.10
Top LB	10.60	105.10
Toe LB	15.80	104.10
Thalweg	16.80	104.10
Toe RB	17.80	104.10
Top RB	23.00	105.10
Fldpln RB	33.00	105.10

Proposed Cross-Section and Structure Geometry (Looking D/S)



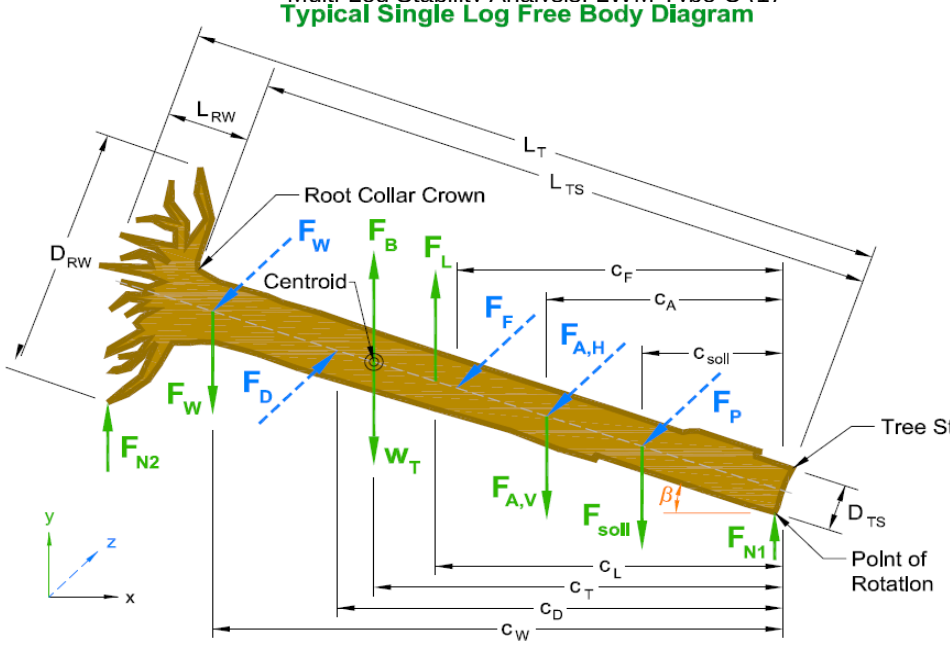
Wood Species	Rootwad	L_T (ft)	D_{TS} (ft)	L_{RW} (ft)	D_{RW} (ft)	γ_{Td} (lb/ft^3)	γ_{Tgr} (lb/ft^3)
Cedar, Western redcedar	Yes	8.0	0.83	1.25	2.50	22.4	27.0

Structure Geometry	θ (deg)	β (deg)	Define Fixed Point	x_T (ft)	y_T (ft)	$y_{T,min}$ (ft)	$y_{T,max}$ (ft)	A_{Tp} (ft^2)
	75.0	-20.0	Root collar: Crown	16.00	104.50	101.41	105.71	1.69

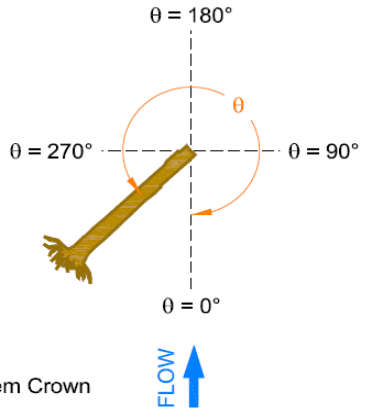
Soils	Material	γ_s (lb/ft^3)	γ'_s (lb/ft^3)	ϕ (deg)	Soil Class	$L_{T,em}$ (ft)	$d_{b,max}$ (ft)	$d_{b,avg}$ (ft)
Stream Bed	Coarse gravel	125.9	78.4	38.0	5	0.00	0.00	0.00
Bank	Fine sand, dense	114.0	71.0	42.0	6	5.90	2.91	1.52

Multi-Log Stability Analysis: LWM Type C (1)

Typical Single Log Free Body Diagram



Log Orientation (Plan View)



Vertical Force Analysis

Net Buoyancy Force

Wood	V_{TS} (ft^3)	V_{RW} (ft^3)	V_T (ft^3)	W_T (lbf)	F_B (lbf)
↑WSE	0.0	0.5	0.5	12	0
↓WS↑Thw	0.2	1.2	1.4	31	86
↓Thalweg	3.5	0.6	4.1	112	258
Total	3.7	2.4	6.0	154	344

Lift Force

C_{LT}	0.03
F_L (lbf)	0

Soil Ballast Force

Soil	V_{dry} (ft^3)	V_{sat} (ft^3)	V_{soil} (ft^3)	F_{soil} (lbf)
Bed	0.0	0.0	0.0	0
Bank	0.6	6.8	7.4	557
Total	0.6	6.8	7.4	557

Vertical Force Balance

F_B (lbf)	344
F_L (lbf)	0
W_T (lbf)	154
F_{soil} (lbf)	557
$F_{W,V}$ (lbf)	0
$F_{A,V}$ (lbf)	0
ΣF_V (lbf)	367
FS_V	2.07

Horizontal Force Analysis

Drag Force

A_{Tp} / A_W	Fr_L	C_{Di}	C_w	C_D*	F_D (lbf)
0.80	0.42	1.14	0.43	45.07	341

Passive Soil Pressure / Friction Force

Soil	K_P	F_P (lbf)	L_{Tf} (ft)	μ	F_F (lbf)
Bed	4.20	0	3.32	0.78	97
Bank	5.04	1,404	6.54	0.90	219
Total	-	1,404	9.86	-	316

Horizontal Force Balance

F_D (lbf)	341
F_P (lbf)	1,404
F_F (lbf)	316
$F_{W,H}$ (lbf)	0
$F_{A,H}$ (lbf)	0
ΣF_H (lbf)	1,378
FS_H	5.04

Moment Force Balance

Driving Moment Centroids / Resisting Moment Centroids

$c_{T,B}$ (ft)	c_L (ft)	c_D (ft)	$c_{T,W}$ (ft)	c_{soil} (ft)	$c_{F\&N}$ (ft)	c_P (ft)
4.9	7.9	7.0	4.9	2.9	3.9	3.9

*Distances are from the stem tip

Point of Rotation: Stem Tip

Moment Force Balance

M_d (lbf)	3,813
M_r (lbf)	9,933
FS_M	2.60

Anchor Forces

Additional Soil Ballast

V_{Adry} (ft^3)	V_{Awet} (ft^3)	c_{Asoil} (ft)	$F_{A,Vsoil}$ (lbf)	$F_{A,HP}$ (lbf)
			0	0

Mechanical Anchors

Type	c_{Am} (ft)	Soils	F_{Am} (lbf)
			0
			0

Boulder Ballast

Position	D_r (ft)	c_{Ar} (ft)	$V_{r,dry}$ (ft^3)	$V_{r,wet}$ (ft^3)	W_r (lbf)	$F_{L,r}$ (lbf)	$F_{D,r}$ (lbf)	$F_{A,Vr}$ (lbf)	$F_{A,Hr}$ (lbf)
Above								0	0
								0	0
								0	0

Spreadsheet developed by
Michael Rafferty, P.E.

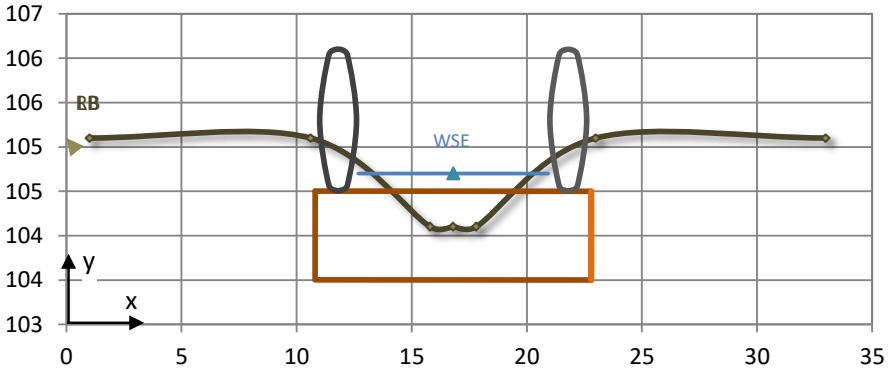
Single Log Stability Analysis Model Inputs

Site ID	Structure Type	Structure Position	Meander	Station	d_w (ft)	R_c/W_{BF}	u_{des} (ft/s)
LWM - Type C (1)	Log Weir	Full span	Straight	0+40	0.60	200.00	2.15

Multi-Log Structures	Layer	Log ID
	Key Log	W1A

Channel Geometry Coordinates		
Proposed	x (ft)	y (ft)
Fldpln LB	1.00	105.10
Top LB	10.60	105.10
Toe LB	15.80	104.10
Thalweg	16.80	104.10
Toe RB	17.80	104.10
Top RB	23.00	105.10
Fldpln RB	33.00	105.10

Proposed Cross-Section and Structure Geometry (Looking D/S)



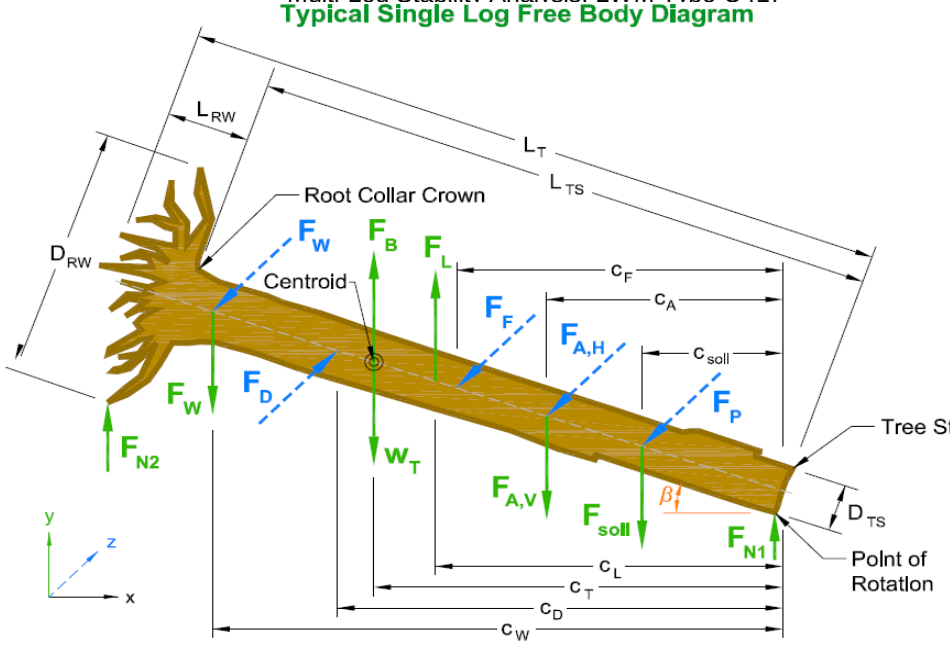
Wood Species	Rootwad	L_T (ft)	D_{TS} (ft)	L_{RW} (ft)	D_{RW} (ft)	γ_{Td} (lb/ft^3)	γ_{Tgr} (lb/ft^3)
Cedar, Western redcedar	No	12.0	1.00	-	-	22.4	27.0

Structure Geometry	θ (deg)	β (deg)	Define Fixed Point	x_T (ft)	y_T (ft)	$y_{T,min}$ (ft)	$y_{T,max}$ (ft)	A_{Tp} (ft^2)
	89.0	0.0	Root collar: Crown	22.80	104.50	103.50	104.50	1.58

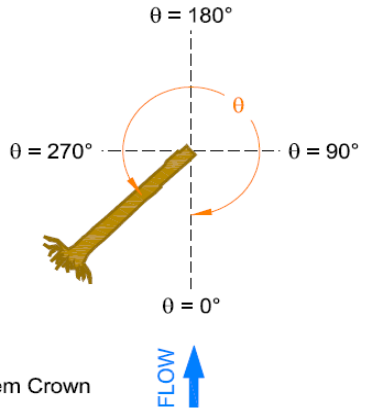
Soils	Material	γ_s (lb/ft^3)	γ'_s (lb/ft^3)	ϕ (deg)	Soil Class	$L_{T,em}$ (ft)	$d_{b,max}$ (ft)	$d_{b,avg}$ (ft)
Stream Bed	Coarse gravel	125.9	78.4	38.0	5	0.00	0.00	0.00
Bank	Fine sand, dense	114.0	71.0	42.0	6	5.83	0.56	0.28

Multi-Log Stability Analysis: LWM Type C (1)

Typical Single Log Free Body Diagram



Log Orientation (Plan View)



Vertical Force Analysis

Net Buoyancy Force

Wood	V_{TS} (ft^3)	V_{RW} (ft^3)	V_T (ft^3)	W_T (lbf)	F_B (lbf)
↑WSE	0.0	0.0	0.0	0	0
↓WS↑Thw	3.5	0.0	3.5	79	220
↓Thalweg	5.9	0.0	5.9	159	368
Total	9.4	0.0	9.4	238	588

Lift Force

C_{LT}	0.00
F_L (lbf)	0

Soil Ballast Force

Soil	V_{dry} (ft^3)	V_{sat} (ft^3)	V_{soil} (ft^3)	F_{soil} (lbf)
Bed	0.0	0.0	0.0	0
Bank	0.7	1.0	1.6	145
Total	0.7	1.0	1.6	145

Vertical Force Balance

F_B (lbf)	588 ↑
F_L (lbf)	0
W_T (lbf)	238 ↓
F_{soil} (lbf)	145 ↓
$F_{W,V}$ (lbf)	0
$F_{A,V}$ (lbf)	696 ↓
ΣF_V (lbf)	491 ↓
FS_V	1.84 ✓

Horizontal Force Analysis

Drag Force

A_{Tp} / A_W	Fr_L	C_{Di}	C_w	C_D*	F_D (lbf)
0.75	0.38	0.93	0.43	23.85	169

Passive Soil Pressure / Friction Force

Soil	K_P	F_P (lbf)	L_{Tf} (ft)	μ	F_F (lbf)
Bed	4.20	0	3.98	0.78	109
Bank	5.04	366	10.02	0.90	317
Total	-	366	14.00	-	426

Horizontal Force Balance

F_D (lbf)	169 →
F_P (lbf)	366 ←
F_F (lbf)	426 ←
$F_{W,H}$ (lbf)	0
$F_{A,H}$ (lbf)	0
ΣF_H (lbf)	623 ←
FS_H	4.69 ✓

Moment Force Balance

Driving Moment Centroids / Resisting Moment Centroids

$c_{T,B}$ (ft)	c_L (ft)	c_D (ft)	$c_{T,W}$ (ft)	c_{soil} (ft)	$c_{F\&N}$ (ft)	c_P (ft)
6.0	0.0	6.0	6.0	6.0	6.0	6.0

*Distances are from the stem tip

Point of Rotation: Root Collar

Moment Force Balance

M_d (lbf)	4,541
M_r (lbf)	14,178
FS_M	3.12 ✓

Anchor Forces

Additional Soil Ballast

V_{Adry} (ft^3)	V_{Awet} (ft^3)	c_{Asoil} (ft)	$F_{A,Vsoil}$ (lbf)	$F_{A,HP}$ (lbf)
			0	0

Mechanical Anchors

Type	c_{Am} (ft)	Soils	F_{Am} (lbf)
			0
			0

Boulder Ballast

Position	D_r (ft)	c_{Ar} (ft)	$V_{r,dry}$ (ft^3)	$V_{r,wet}$ (ft^3)	W_r (lbf)	$F_{L,r}$ (lbf)	$F_{D,r}$ (lbf)	$F_{A,Vr}$ (lbf)	$F_{A,Hr}$ (lbf)
Above	1.60	1.0	2.1	0.1	348	0	0	348	0
Above	1.60	11.0	2.1	0.1	348	0	0	348	0
								0	0

Building X

Spreadsheet developed by
Michael Rafferty, P.E.

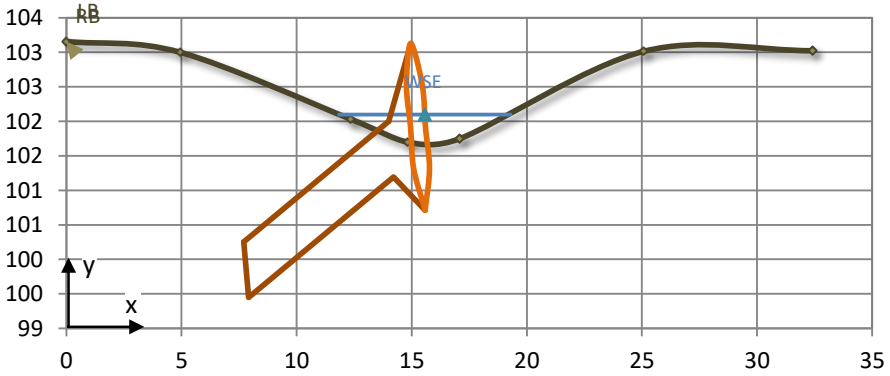
Single Log Stability Analysis Model Inputs

Site ID	Structure Type	Structure Position	Meander	Station	d_w (ft)	R_c/W_{BF}	u_{des} (ft/s)
LWM - Type C (2)	Rootwad	Left bank	Straight	0+83	0.40	125.00	1.85

Multi-Log Structures	Layer	Log ID
	Footer	W2

Channel Geometry Coordinates		
Proposed	x (ft)	y (ft)
Fldpln LB	0.00	103.16
Top LB	4.94	103.00
Toe LB	12.35	102.03
Thalweg	14.83	101.70
Toe RB	17.10	101.75
Top RB	25.09	103.02
Fldpln RB	32.43	103.02

Proposed Cross-Section and Structure Geometry (Looking D/S)



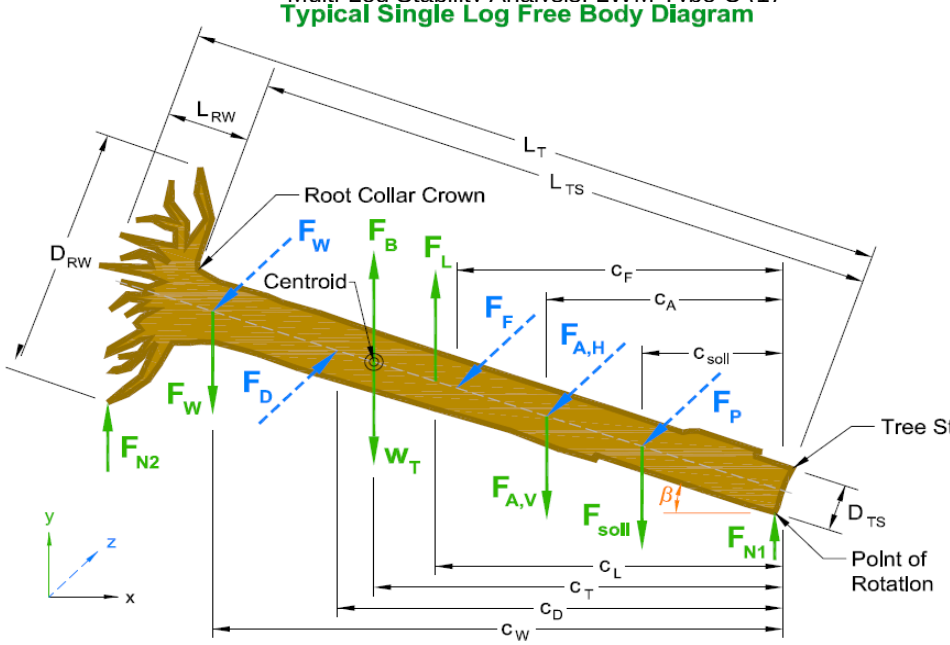
Wood Species	Rootwad	L_T (ft)	D_{TS} (ft)	L_{RW} (ft)	D_{RW} (ft)	γ_{Td} (lb/ft^3)	γ_{Tgr} (lb/ft^3)
Cedar, Western redcedar	Yes	8.0	0.83	1.25	2.50	22.4	27.0

Structure Geometry	θ (deg)	β (deg)	Define Fixed Point	x_T (ft)	y_T (ft)	$y_{T,min}$ (ft)	$y_{T,max}$ (ft)	A_{Tp} (ft^2)
	75.0	-15.0	Root collar: Crown	14.00	102.00	99.45	103.13	0.97

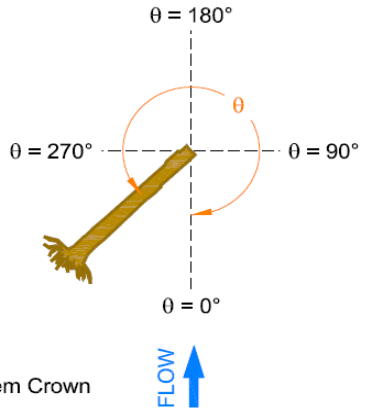
Soils	Material	γ_s (lb/ft^3)	γ'_s (lb/ft^3)	ϕ (deg)	Soil Class	$L_{T,em}$ (ft)	$d_{b,max}$ (ft)	$d_{b,avg}$ (ft)
Stream Bed	Coarse gravel	125.9	78.4	38.0	5	1.27	0.48	0.24
Bank	Fine sand, dense	114.0	71.0	42.0	6	4.99	2.39	1.44

Multi-Log Stability Analysis: LWM Type C (1)

Typical Single Log Free Body Diagram



Log Orientation (Plan View)



Vertical Force Analysis

Net Buoyancy Force

Wood	V_{TS} (ft^3)	V_{RW} (ft^3)	V_T (ft^3)	W_T (lbf)	F_B (lbf)
↑WSE	0.0	0.6	0.6	14	0
↓WS↑Thw	0.1	0.8	0.9	20	57
↓Thalweg	3.6	0.9	4.5	122	282
Total	3.7	2.4	6.0	156	339

Lift Force

C_{LT}	0.00
F_L (lbf)	0

Soil Ballast Force

Soil	V_{dry} (ft^3)	V_{sat} (ft^3)	V_{soil} (ft^3)	F_{soil} (lbf)
Bed	0.0	0.3	0.3	20
Bank	1.0	5.0	6.0	467
Total	1.0	5.2	6.2	487

Vertical Force Balance

F_B (lbf)	339	↑
F_L (lbf)	0	
W_T (lbf)	156	↓
F_{soil} (lbf)	487	↓
$F_{W,V}$ (lbf)	0	
$F_{A,V}$ (lbf)	0	
ΣF_V (lbf)	304	↓
FS_V	1.90	✓

Horizontal Force Analysis

Drag Force

A_{Tp} / A_W	Fr_L	C_{Di}	C_w	C_D*	F_D (lbf)
0.49	0.36	1.14	0.43	6.18	20

Passive Soil Pressure / Friction Force

Soil	K_P	F_P (lbf)	L_{Tf} (ft)	μ	F_F (lbf)
Bed	4.20	43	5.02	0.78	119
Bank	5.04	1,177	4.98	0.90	137
Total	-	1,220	10.00	-	256

Horizontal Force Balance

F_D (lbf)	20	→
F_P (lbf)	1,220	←
F_F (lbf)	256	←
$F_{W,H}$ (lbf)	0	
$F_{A,H}$ (lbf)	0	
ΣF_H (lbf)	1,456	←
FS_H	73.87	✓

Moment Force Balance

Driving Moment Centroids / Resisting Moment Centroids

$c_{T,B}$ (ft)	c_L (ft)	c_D (ft)	$c_{T,W}$ (ft)	c_{soil} (ft)	$c_{F\&N}$ (ft)	c_P (ft)
4.9	0.0	7.1	4.9	3.1	4.0	4.2

*Distances are from the stem tip

Point of Rotation: Stem Tip

Moment Force Balance

M_d (lbf)	1,745
M_r (lbf)	9,275
FS_M	5.32 ✓

Anchor Forces

Additional Soil Ballast

V_{Adry} (ft^3)	V_{Awet} (ft^3)	c_{Asoil} (ft)	$F_{A,Vsoil}$ (lbf)	$F_{A,HP}$ (lbf)
			0	0

Mechanical Anchors

Type	c_{Am} (ft)	Soils	F_{Am} (lbf)
			0
			0

Boulder Ballast

Position	D_r (ft)	c_{Ar} (ft)	$V_{r,dry}$ (ft^3)	$V_{r,wet}$ (ft^3)	W_r (lbf)	$F_{L,r}$ (lbf)	$F_{D,r}$ (lbf)	$F_{A,Vr}$ (lbf)	$F_{A,Hr}$ (lbf)
								0	0
								0	0
								0	0

Spreadsheet developed by
Michael Rafferty, P.E.

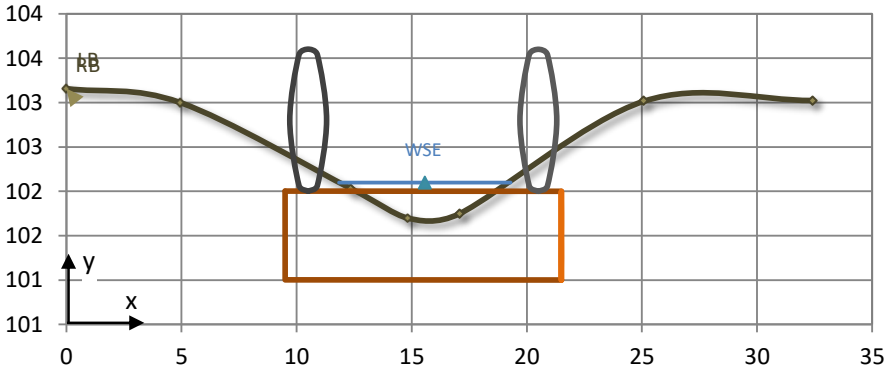
Single Log Stability Analysis Model Inputs

Site ID	Structure Type	Structure Position	Meander	Station	d_w (ft)	R_c/W_{BF}	u_{des} (ft/s)
LWM - Type C (2)	Log Weir	Full span	Straight	0+83	0.40	125.00	1.85

Multi-Log Structures	Layer	Log ID
	Key Log	W2

Channel Geometry Coordinates		
Proposed	x (ft)	y (ft)
Fldpln LB	0.00	103.16
Top LB	4.94	103.00
Toe LB	12.35	102.03
Thalweg	14.83	101.70
Toe RB	17.10	101.75
Top RB	25.09	103.02
Fldpln RB	32.43	103.02

Proposed Cross-Section and Structure Geometry (Looking D/S)



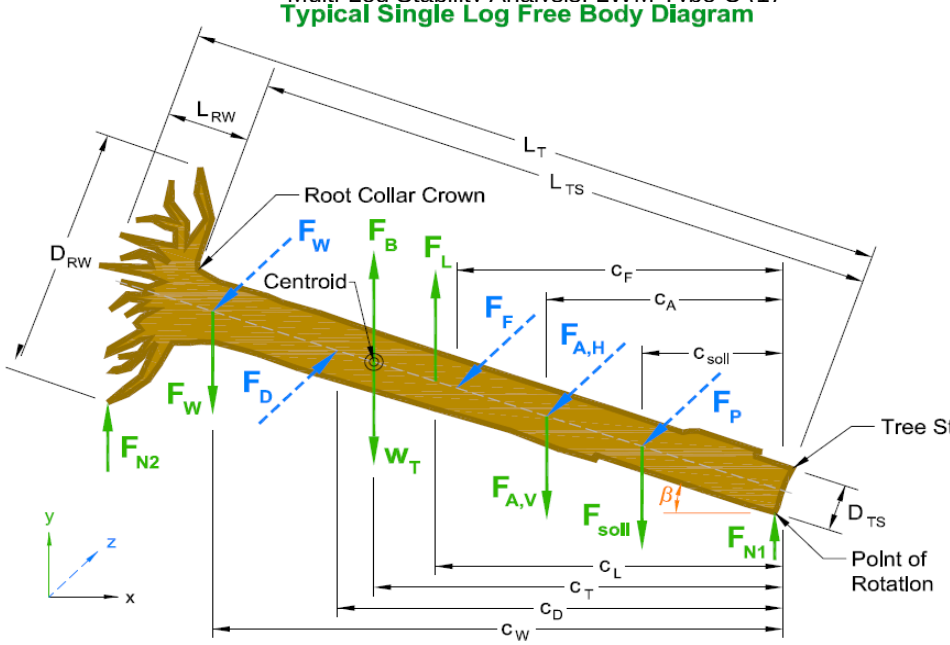
Wood Species	Rootwad	L_T (ft)	D_{TS} (ft)	L_{RW} (ft)	D_{RW} (ft)	γ_{Td} (lb/ft^3)	γ_{Tgr} (lb/ft^3)
Cedar, Western redcedar	No	12.0	1.00	-	-	22.4	27.0

Structure Geometry	θ (deg)	β (deg)	Define Fixed Point	x_T (ft)	y_T (ft)	$y_{T,min}$ (ft)	$y_{T,max}$ (ft)	A_{Tp} (ft^2)
	89.0	0.0	Root collar: Crown	21.50	102.00	101.00	102.00	1.11

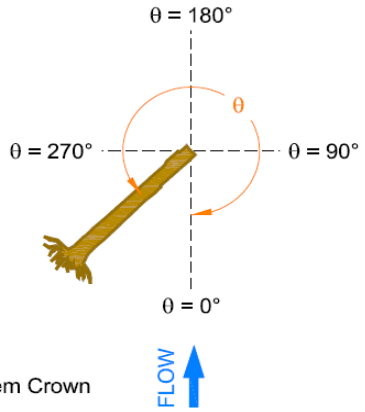
Soils	Material	γ_s (lb/ft^3)	γ'_s (lb/ft^3)	ϕ (deg)	Soil Class	$L_{T,em}$ (ft)	$d_{b,max}$ (ft)	$d_{b,avg}$ (ft)
Stream Bed	Coarse gravel	125.9	78.4	38.0	5	0.22	0.03	0.01
Bank	Fine sand, dense	114.0	71.0	42.0	6	5.67	0.45	0.22

Multi-Log Stability Analysis: LWM Type C (1)

Typical Single Log Free Body Diagram



Log Orientation (Plan View)



Vertical Force Analysis

Net Buoyancy Force

Wood	V_{TS} (ft^3)	V_{RW} (ft^3)	V_T (ft^3)	W_T (lbf)	F_B (lbf)
↑WSE	0.0	0.0	0.0	0	0
↓WS↑Thw	2.4	0.0	2.4	54	150
↓Thalweg	7.0	0.0	7.0	189	438
Total	9.4	0.0	9.4	243	588

Soil Ballast Force

Soil	V_{dry} (ft^3)	V_{sat} (ft^3)	V_{soil} (ft^3)	F_{soil} (lbf)
Bed	0.0	0.0	0.0	0
Bank	0.7	0.5	1.2	120
Total	0.7	0.5	1.2	121

Lift Force

C_{LT}	0.00
F_L (lbf)	0

Vertical Force Balance

F_B (lbf)	588 ↑
F_L (lbf)	0
W_T (lbf)	243 ↓
F_{soil} (lbf)	121 ↓
$F_{W,V}$ (lbf)	0
$F_{A,V}$ (lbf)	705 ↓
ΣF_V (lbf)	481 ↓
FS_V	1.82 ✓

Horizontal Force Analysis

Drag Force

A_{Tp} / A_W	Fr_L	C_{Di}	C_w	C_D*	F_D (lbf)
0.55	0.33	0.93	0.43	7.15	26

Passive Soil Pressure / Friction Force

Soil	K_P	F_P (lbf)	L_{Tf} (ft)	μ	F_F (lbf)
Bed	4.20	1	6.74	0.78	181
Bank	5.04	304	7.26	0.90	224
Total	-	304	14.00	-	405

Horizontal Force Balance

F_D (lbf)	26 →
F_P (lbf)	304 ←
F_F (lbf)	405 ←
$F_{W,H}$ (lbf)	0
$F_{A,H}$ (lbf)	0
ΣF_H (lbf)	683 ←
FS_H	26.95 ✓

Moment Force Balance

Driving Moment Centroids / Resisting Moment Centroids

$c_{T,B}$ (ft)	c_L (ft)	c_D (ft)	$c_{T,W}$ (ft)	c_{soil} (ft)	$c_{F\&N}$ (ft)	c_P (ft)
6.0	0.0	6.1	6.0	5.9	6.0	6.0

*Distances are from the stem tip

Point of Rotation: Root Collar

Moment Force Balance

M_d (lbf)	3,683
M_r (lbf)	13,569
FS_M	3.68 ✓

Anchor Forces

Additional Soil Ballast

V_{Adry} (ft^3)	V_{Awet} (ft^3)	c_{Asoil} (ft)	$F_{A,Vsoil}$ (lbf)	$F_{A,HP}$ (lbf)
			0	0

Mechanical Anchors

Type	c_{Am} (ft)	Soils	F_{Am} (lbf)
			0
			0

Boulder Ballast

Position	D_r (ft)	c_{Ar} (ft)	$V_{r,dry}$ (ft^3)	$V_{r,wet}$ (ft^3)	W_r (lbf)	$F_{L,r}$ (lbf)	$F_{D,r}$ (lbf)	$F_{A,Vr}$ (lbf)	$F_{A,Hr}$ (lbf)
Above	1.60	1.0	2.1	0.0	352	0	0	352	0
Above	1.60	11.0	2.1	0.0	352	0	0	352	0
								0	0

Building X
Notation, Units, and List of Symbols

Notation

Symbol	Description	Unit
A_W	Wetted area of channel at design discharge	ft^2
A_{Tp}	Projected area of wood in plane perpendicular to flow	ft^2
c_D	Centroid of the drag force along log axis	ft
c_{Am}	Centroid of a mechanical anchor along log axis	ft
c_{Ar}	Centroid of a ballast boulder along log axis	ft
c_{Asoil}	Centroid of the added ballast soil along log axis	ft
$c_{F\&N}$	Centroid of friction and normal forces along log axis	ft
c_L	Centroid of the lift force along log axis	ft
c_P	Centroid of the passive soil force along log axis	ft
c_{soil}	Centroid of the vertical soil forces along log axis	ft
$c_{T,B}$	Centroid of the buoyancy force along log axis	ft
$c_{T,W}$	Centroid of the log volume along log axis	ft
c_{WI}	Centroid of a wood interaction force along log axis	ft
C_{Lrock}	Coefficient of lift for submerged boulder	-
C_{LT}	Effective coefficient of lift for submerged tree	-
C_{Di}	Base coefficient of drag for tree, before adjustments	-
C_D*	Effective coefficient of drag for submerged tree	-
C_{Di}	Base coefficient of drag for tree, before adjustments	-
C_W	Wave drag coefficient of submerged tree	-
$d_{b,avg}$	Average buried depth of log	ft
$d_{b,max}$	Maximum buried depth of log	ft
d_w	Maximum flow depth at design discharge in reach	ft
D_{50}	Median grain size in millimeters (SI units)	mm
D_r	Equivalent diameter of boulder	ft
D_{RW}	Assumed diameter of rootwad	nalysis: LWM
D_{TS}	Nominal diameter of tree stem (DBH)	nalysis: LWM
DF_{RW}	Diameter factor for rootwad ($DF_{RW} = D_{RW}/D_{TS}$)	-
e	Void ratio of soils	-
$F_{A,H}$	Total horizontal load capacity of anchor techniques	lbf
$F_{A,HP}$	Passive soil pressure applied to log from soil ballast	lbf
$F_{A,Hr}$	Horizontal resisting force on log from boulder	lbf
F_{Am}	Load capacity of mechanical anchor	lbf
$F_{A,V}$	Total vertical load capacity of anchor techniques	lbf
$F_{A,Vr}$	Vertical resisting force on log from boulder	lbf
$F_{A,Vsoil}$	Vertical soil loading on log from added ballast soil	lbf
F_B	Buoyant force applied to log	lbf
F_D	Drag forces applied to log	lbf
$F_{D,r}$	Drag forces applied to boulder	lbf
F_F	Friction force applied to log	lbf
F_H	Resultant horizontal force applied to log	lbf
F_L	Lift force applied to log	lbf
$F_{L,r}$	Lift force applied to boulder	lbf
F_P	Passive soil pressure force applied to log	lbf
F_{soil}	Vertical soil loading on log	lbf
$F_{W,H}$	Horizontal forces from interactions with other logs	lbf
$F_{W,V}$	Vertical forces from interactions with other logs	lbf

Notation (continued)

Symbol	Description	Unit
F_V	Resultant vertical force applied to log	lbf
Fr_L	Log Froude number	-
FS_V	Factor of Safety for Vertical Force Balance	-
FS_H	Factor of Safety for Horizontal Force Balance	-
FS_M	Factor of Safety for Moment Force Balance	-
g	Gravitational acceleration constant	ft/s^2
K_P	Coefficient of Passive Earth Pressure	-
$L_{T,em}$	Total embedded length of log	ft
L_{RW}	Assumed length of rootwad	ft
L_T	Total length of tree (including rootwad)	ft
L_{Tf}	Length of log in contact with bed or banks	ft
L_{TS}	Length of tree stem (not including rootwad)	ft
$L_{TS,ex}$	Exposed length of tree stem	ft
LF_{RW}	Length factor for rootwad ($LF_{RW} = L_{RW}/D_{TS}$)	-
M_d	Driving moment about embedded tip	lbf
M_r	Driving moment about embedded tip	lbf
N	Blow count of standard penetration test	-
p_o	Porosity of soil volume	-
Q_{des}	Design discharge	cfs
R	Radius	ft
R_c	Radius of curvature at channel centerline	ft
SG_r	Specific gravity of quartz particles	-
SG_T	Specific gravity of tree	-
u_{avg}	Average velocity of cross section in reach	ft/s
u_{des}	Design velocity	ft/s
u_m	Adjusted velocity at outer meander bend	ft/s
V_{dry}	Volume of soils above stage level of design flow	ft^3
V_{sat}	Volume of soils below stage level of design flow	ft^3
V_{soil}	Total volume of soils over log	ft^3
V_{RW}	Volume of rootwad	ft^3
V_S	Volume of solids in soil (void ratio calculation)	ft^3
V_T	Total volume of log	ft^3
V_{TS}	Total volume of tree	ft^3
V_V	Volume of voids in soil	ft^3
V_{Adry}	Volume of ballast above stage of design flow	ft^3
V_{Awet}	Volume of ballast below stage of design flow	ft^3
$V_{r,dry}$	Volume of boulder above stage of design flow	ft^3
$V_{r,wet}$	Volume of boulder below stage of design flow	ft^3
W_{BF}	Bankfull width at structure site	ft
W_r	Effective weight of boulder	lbf
W_T	Total log weight	lbf
x	Horizontal coordinate (distance)	ft
y	Vertical coordinate (elevation)	ft
$y_{T,max}$	Minimum elevation of log	ft
$y_{T,min}$	Maximum elevation of log	ft

Greek Symbols

Symbol	Description	Unit
β	Tilt angle from stem tip to vertical	deg
γ_{bank}	Dry specific weight of bank soils	lb/ft^3
$\gamma_{bank,sat}$	Saturated unit weight of bank soils	lb/ft^3
γ'_{bank}	Effective buoyant unit weight of bank soils	lb/ft^3
γ_{bed}	Dry specific weight of stream bed substrate	lb/ft^3
γ'_{bed}	Effective buoyant unit weight of stream bed substrate	lb/ft^3
γ_{rock}	Dry unit weight of boulders	lb/ft^3
γ_s	Dry specific weight of soil	lb/ft^3
γ'_s	Effective buoyant unit weight of soil	lb/ft^3
γ_{Td}	Air-dried unit weight of tree (12% MC basis)	lb/ft^3
γ_{Tgr}	Green unit weight of tree	lb/ft^3
γ_w	Specific weight of water at 50ºF	lb/ft^3
η	Rootwad porosity	-
θ	Rootwad (or large end of log) orientation to flow	deg
μ	Coefficient of friction	-
ν	Kinematic viscosity of water at 50ºF	ft/s^2
Σ	Sum of forces	-
ϕ_{bank}	Internal friction angle of bank soils	deg
ϕ_{bed}	Internal friction angle of stream bed substrate	deg

Units

Notation	Description
cfs	Cubic feet per second
ft	Feet
lb	Pound
lbf	Pounds force
kg	Kilograms
m	Meters
mm	Millimeters
s	Seconds
yr	Year

Abbreviations

Notation	Description
ARI	Average return interval
Avg	Average
DBH	Diameter at breast height
deg	Degrees
Dia	Diameter
Dist	Distance
D/S	Downstream
ELJ	Engineered log jam
Ex	Example
Fldpln	Floodplain
H&H	Hydrologic and hydraulic
ID	Identification
i.e.	That is
LB	Left bank
LW	Large wood
Max	Maximum
MC	Moisture content
Min	Minimum
ML	Multi-log
SL	Single log
N/A	Not applicable
no	Number
Pt	Point
rad	Radians
RB	Right bank
RW	Rootwad
SL	Single log
Thw	Thalweg (lowest elevation in channel bed)
Typ	Typical
U.S.	United States
WS	Water surface
WSE	Water surface elevation
↑	Above
↓	Below

APPENDIX F
Report Limitations and Guidelines for Use

APPENDIX F
REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

This appendix provides information to help you manage your risks with respect to the use of this report.

Read These Provisions Closely

Some clients, design professionals and contractors may not recognize that stream and river engineering analysis and design practices are less exact than other engineering and natural science disciplines. Such misunderstanding can create unrealistic expectations, sometimes leading to disappointments, claims and disputes. GeoEngineers includes these explanatory "limitations" provisions in our reports to help reduce such risks. Please confer with GeoEngineers if you are unclear how these "Report Limitations and Guidelines for Use" apply to your project or site.

Stream and River Design Engineering Services Are Performed for Specific Purposes, Persons and Projects

This report has been prepared for Willow Run, LLC and their authorized agents and regulatory agencies for use on the Project(s) specifically identified in the report. The information contained herein is not applicable to other sites or projects.

GeoEngineers structures its services to meet the specific needs of its clients. No party other than Willow Run, LLC may rely on the product of our services unless we agree to such reliance in advance and in writing. Within the limitations of the agreed scope of services for the Project(s), and its (their) schedule and budget, our services have been executed in accordance with our Agreement with the Client dated July 31, 2018 and generally accepted practices in this area at the time this report was prepared. We do not authorize and will not be responsible for, the use of this report is not recommended for any purposes or projects other than those identified in the report.

A Stream or River Design Engineering Report is Based on a Unique Set of Project-Specific Factors

This report has been prepared for Building X Large Woody Material (LWM) Stability Analysis ("Project"). GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, it is important not to rely on this report if it was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site, or
- completed before project changes were made.

For example, changes that can affect the applicability of this report include those that affect:

1 Developed based on material provided by GBA, GeoProfessional Business Association; www.geoprofessional.org.

- the function of the proposed design and/or structure;
- elevation, configuration, location, orientation or weight of the proposed structures;
- composition of the design team; or
- project ownership.

If changes occur after the date of this report, GeoEngineers cannot be responsible for any consequences of such changes in relation to this report unless we have been given the opportunity to review our interpretations and recommendations in the context of such changes. Based on that review, we can provide written modifications or confirmation, as appropriate.

Conditions Can Change

This report is based on conditions that existed at the time the study/design was performed. The findings and conclusions of this report may be affected by the passage of time, by man-made events such as construction on or adjacent to the site, new information or technology that becomes available subsequent to the report date, or by natural events such as floods, earthquakes, slope instability, stream flow fluctuations or stream channel fluctuations. If more than a few months have passed since issuance of our report or work product, or if any of the described events may have occurred, please contact GeoEngineers before applying this report for its intended purpose so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Report Recommendations and Designs Are Not Final

The recommendations included in this report are preliminary and should not be considered final. The designs depicted herein are approximate and are intended to express the overall design intent of the Project, and need to be adjusted in the field during construction in order to meet the specific-site conditions and intended function. GeoEngineers' recommendations can be finalized only by observing actual site-specific conditions revealed during construction.

We recommend that you allow sufficient monitoring and consultation by GeoEngineers during construction to confirm that the conditions encountered are consistent with those indicated in the report, to provide recommendations for design changes if the conditions revealed during the work differ from those anticipated and to evaluate whether construction activities are completed in accordance with our recommendations. GeoEngineers cannot assume responsibility for the recommendations in this report if we do not perform construction observation.

Report Could Be Subject to Misinterpretation

Misinterpretation of this report by members of the design team or by contractors can result in costly problems. GeoEngineers can help reduce the risks of misinterpretation by conferring with appropriate members of the design team after submitting the report, reviewing pertinent elements of the design team's plans and specifications, participating in pre-bid and preconstruction conferences, and providing construction observation.

To help reduce the risk of problems, we recommend giving contractors the complete report, including these "Report Limitations and Guidelines for Use." When providing the report, you preface it with a clearly written letter of transmittal that:

- advises contractors that the report was not prepared for purposes of bid development and that its accuracy is limited; and
- encourages contractors to confer with GeoEngineers and/or to conduct additional study to obtain the specific types of information they need or prefer.

Hazards of Instream Habitat Structures

Instream habitat structures ("Structures") create potential hazards, including, but not limited to:

- persons falling from the Structures and associated injury or death;
- collisions of recreational users' and their watercraft with the Structures, and associated risk of injury, and damage of the watercraft;
- mobilization of a portion or all of the Structures during high water flow conditions and related damage to downstream persons and property;
- flooding;
- erosion; and
- channel avulsion.

In some cases, instream habitat structures are only intended to be temporary, providing temporary stabilization while riparian vegetation becomes established while or stream/river processes stabilize. This gradual deterioration with age and vulnerability to major flood events make the risks with temporary Structures inherently greater with their increasing age.

GeoEngineers strongly recommends that the Client appropriately address safety concerns, including but not limited to warning construction workers of hazards associated with working in or near deep and fast moving water and on steep, slippery and unstable slopes. In addition, signs should be placed along the enhanced stream reaches in prominent locations to warn third parties, such as nearby residents and recreational users, of the potential hazards noted above.

Increased Flood Elevations and Wetland Expansion Are Possible

The proposed stream enhancements may result in increased flood elevations and expansion of wetlands. These impacts are generally considered advantageous for aquatic and riparian habitat in the project locations of these stream systems, but the analysis, consideration and quantification of these impacts is beyond the scope of this report, unless expressly included within GeoEngineers' scope of services.

Channel Erosion and Migration Are Possible

In general, river and stream enhancements result in more stable streambeds, banks and floodplains. In some cases, stream enhancement and channel stability includes reestablishing the natural balance of sediment erosion, distribution and deposition, which in some cases may induce channel meandering and migration. Therefore, channel erosion, channel migration and/or avulsions can occur over time.

Importance of Monitoring and Maintenance

In some instances, GeoEngineers may have purposely excluded piles, anchors, chains, cables, reinforcing bars, bolts and similar fasteners from woody habitat structures with the intent of mimicking naturally-

occurring instream wood structures. In other instances, GeoEngineers may have purposely included such fasteners may have purposely been included in woody habitat Structures, if considered appropriate. While GeoEngineers designs Structures to be relatively stable during flood events, some movement of these Structures is expected. We recommend that the Client implement appropriate monitoring and maintenance procedures to minimize potential adverse impacts at or near areas of concern, such as at downstream road, bridge and/or culvert crossings, including replacing, adjusting and removing damaged, malfunctioning or deteriorated components of Structures, particularly after a major storm event.

Contractors Are Responsible for Site Safety on Their Own Construction Projects

Our recommendations are not intended to direct the contractor's procedures, means, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and adjacent properties.

Information Provided by Others

GeoEngineers has relied upon certain data or information provided or compiled by others in the performance of our services. Although we use sources that we reasonably believe to be trustworthy, GeoEngineers cannot warrant or guarantee the accuracy or completeness of information provided or compiled by others.

GeoEngineers

Appendix E:

Site Photo-document

The following is a compilation of photos taken on 12 and 22 June 2018 of the Building “X” Project that illustrate existing site conditions.

Photo 1. Stream 1 looking southwest from the northwest parking lot area on Parcel A. Orange pin-flags were used to delineate the OHWM (dashed yellow line). Photo date: 12 June 2018.

Photo 2. Stream 1 looking east northeast from the northwest parking lot area on Parcel A. This is the first culvert that Stream 1 passes through. The road bridging the culvert connects the parking lot of Parcel A with the adjacent property to the north. Photo date: 12 June 2018.

Photo 3. The outlet to the culvert in Figure 2, facing southwest. Photo date: 12 June 2018.

Photo 4. Stream 1 facing east from the outlet of the first culvert (Photo 3). The buffer of Stream 1 is mostly developed as Site access to the south and maintained as landscaping to the North. Photo date: 12 June 2018.

Photo 5. Sample Point TP-UPL-1 Typical Vegetation.
Photo date 22 June 2018. Vegetation includes sword fern, trailing blackberry, salmonberry, big-leave maple, and vine maple.

Photo 6. Photo of N/S oriented trail, west of developed Site area facing north towards TP-UPL-2 and TP-UPL-3 at property corner of Parcel A and Parcel B. Photo date 22 June 2018. Vegetation includes Douglas fir, sword fern, and Indian plum.

Photo 7. Sample Point TP-UPL-2 Typical Vegetation.
Photo date 22 June 2018. Vegetation includes western hemlock, vine maple, salmonberry, and sword fern.

Photo 8. Sample Point TP-UPL-3. No hydrology (soil saturation or water table) present to within 20 inches of the soil surface.
Photo date 22 June 2018.

Photo 9. Representative vegetation in general area of TP-UPL-4. Vegetation includes Indian plum, trailing blackberry, herb Robert, sword fern, Douglas fir, and big-leaf maple. Photo date: 22 June 2018.

Photo 10. Sample Point TP-UPL-5 Typical Vegetation. Vegetation includes red alder, bitter cherry, salmonberry, and giant fringecup. Photo date: 22 June 2018.

Photo 11. Sample Point TP-UPL-6. Typical vegetation includes Himalayan Blackberry and Salmonberry. Photo date: 22 June 2018.

Photo 12. Panorama of Sample Point TP-UPL-6. Vegetation includes Himalayan blackberry, salmonberry, and pink honeysuckle. Photo date: 22 June 2018.

Appendix F:

City of Redmond Critical Area Forms:

Stream Summary Sheet

Wetland Summary Sheet

Habitat Unit Assessment Form

STREAM SUMMARY SHEET

Stream Summary			Buffer Summary			Riparian Corridor Summary		
Label[1]	Type[2]	Linear Feet[3]	Required[4]	Proposed[5]	Averaging[6]	Disturbed Area[7]	Filled Area[8]	Mitigation Area[9]
1	IV	749 lf	25'	25'	N/A	4,833 sf	2,569 sf	16,371 sf

[1] Stream A, B, C, etc.
[2] Stream type per City stream classification system.
[3] Length of stream on the property.
[4] Required buffer width in feet per RCDG.
[5] Proposed buffer width in feet.
[6] Note if buffer averaging is used. If so, identify minimum and maximum buffer widths in feet as well as area in square feet contained within the buffer prior to and after averaging.
[7] Area of buffer that is disturbed in square feet.
[8] Area of buffer to be filled in square feet, such as for a road crossing.
[9] Location and size in square feet of riparian corridor mitigation.

WETLAND SUMMARY SHEET

Wetland Summary			Buffer Summary				Wetland Impacts		Mitigation Summary		
Label[1]	Category[2]	Size[3]	Required[4]	Proposed[5]	Increase[6] Reduce[7]	Averaging[8]	Fill[9]	Paper Fill[10]	Ratio[11]	Area[12]	Location[13]
A	IV	1936 sf	40'	37.5'	-12.5'	yes/ 53'	0	468 sf	1:1	490 sf	W1.3

per RZC 21.64.030.B.6.a.ii

per RZC 21.64.030.C.8.d

per RZC Table 21.64.030B; 1:1 creation plus >2:1 (required) enhancement at 1,429 sf ; See plan sheet W1.2, Appendix A

[1] Wetland A, B, C, etc.
[2] Wetland category per City wetland classification system.
[3] Area of wetland.
[4] Required buffer width in feet per RCDG.
[5] Proposed buffer width in feet.
[6] Does the uniqueness of the wetland require an increased buffer? If so, what is the width in feet.
[7] Is there a request to reduce the buffer width? If so, what is the width in feet.
[8] Is buffer averaging being used? If so, what is the average buffer width in feet.
[9] Amount of wetland fill.
[10] Amount of paper fill.
[11] Required ratio for wetland mitigation per RCDG.
[12] Size of mitigation area.
[13] Note location of mitigation area (keyed to the mitigation map).

CITY OF REDMOND
HABITAT UNIT ASSESSMENT FORM

HABITAT UNIT: Building X Project
LOCATION: 10301 Willows Road NE, Redmond, WA
TOTAL SCORE: 13

Habitat Parameter	Scoring Criteria	Habitat Unit Score
Size	• >50 acres = 3 points • 10-50 acres = 2 points • 0-10 acres = 1 point	2
Vegetation Community Types	≥ 4 types = 3 points • 2-3 types = 2 points • 1 type = 1 point • None = 0 points	2
Community Interspersion	• High = 3 points • Medium = 2 points • Low = 1 point • None = 0 points	1
Priority Species Presence	• Threatened & Endangered Species = 3 points • Candidate Species = 2 points • Monitor Species = 1 point • None = 0 points	0
Priority Species Habitat Use	• Breeding = 3 points • Roosting = 2 points • Foraging = 1 point • None = 0 points	0
Habitat Continuity	• Links protected habitats = 3 points • Links unprotected habitats = 2 points • Extends habitat corridor = 1 point • None = 0 points	1
Forest Vegetation Layers	• 3 layers = 3 points • 2 layers = 2 points • 1 layers = 1 point • None = 0 points	3
Forest Age	• Mature = 3 points • Pole = 2 points • Seedling/Shrub = 1 point • None = 0 points	2
Invasive Species Presence	• 0-25% = 3 points • 26-50% = 2 points • 51-75% = 1 point • 75-100% = 0 points	2

Appendix G:

City of Redmond
Bond Quantity Worksheet

STREAM MITIGATION

SECURITY WORKSHEET

File No. _____

File Name: Building X

Prepared by: Eva Parker

Date: 10/23/2019

Approved by: _____

Plant Material	$ 12,091.90
Irrigation	$ 1,620.00
Labor (Installation)[1]	$ 35,973.48
Monitoring (5 years)	$ 6,750.00
Subtotal	$ 56,435.38
125% Contingency[2]	$ 70,544.23
Subtotal	$ 126,979.61
9.5% Sales Tax	$ 12,063.06

WETLAND MITIGATION BOND AMOUNT TOTAL $ 139,042.67

[1]Includes plantings, in-stream work, soil amendments, grading work, etc.
[2]Per Ordinance 1693

NOTE: Attach estimate by stream consultant to substantiate security amount.

King County
Department of Permitting and Environmental Review
35030 SE Douglas Str, Suite 210
Snoqualmie, WA 98065-9266
206-296-6600 TTY Relay: 711

Critical Areas Mitigation
Bond Quantity Worksheet

C24 09/09/2015
ls-wks-sensareaBQ.xls
ls-wks-sensareaBQ.pdf

Project Name: Building X **Date:** 23-Oct-19 **Prepared by:** EParker

Project Number: TAL 1732 **Project Description:** North Site, Critical Areas: Relocated Stream and paper fill wetland

Location: 10301 Willows Road NE, Redmond, WA **Applicant:** Willow Run, LLC **Phone:** 650 313-4821

PLANT MATERIALS

Type	Unit Price	Unit	Quantity	Description	Cost
PLANTS: Container, 1 gallon, medium soil	$4.00	Each	2529.00		$ 10,116.00
PLANTS: Container, 2 gallon, medium soil	$6.30	Each	78.00		$ 491.40
PLANTS: Container, 5 gallon, medium soil	$14.00	Each	98.00		$ 1,372.00
PLANTS: Stakes (willow)	$1.50	Each	75.00		$ 112.50
PLANTS: Flats/plugs	$1.05	Each	1750.00		$ 1,837.50
PLANTS: 6' conifers	$55.00	Each	73.00		$ 4,015.00
PLANTS: 2" deciduous	$200.00	Each	3.00		$ 600.00
				TOTAL	**$ 12,091.90**

INSTALLATION COSTS (LABOR, EQUIPMENT, & OVERHEAD)

Type	Unit Price	Unit			Cost
Labor Topsoil spread	$40.00	HR	87.33		$ 3,493.20
Labor, plant installation	$40.00	HR	585.35		$ 23,414.00
Labor, general (grading & construction of streams,place LWM, fence)	$40.00	HR	160.00		$ 6,400.00
Tilling topsoil, disk harrow, 20hp tractor, 4"-6" deep	$1.02	SY	2614.00		$ 2,666.28
				TOTAL	**$ 35,973.48**
Irrigation - temporary	$3,000.00	Acre	0.54		**$ 1,620.00**
				(Construction Cost Subtotal)	**$ 49,685.38**

MAINTENANCE AND MONITORING

NOTE: Projects with multiple permit requirements may be required to have longer monitoring and maintenance terms. This will be evaluated on a case-by-case basis for development applications. Monitoring and maintance ranges may be assessed anywhere from 5 to 10 years.

Maintenance, annual (by owner or consultant)					
Larger than 5,000 sq.ft. but < 1 acre with wetland or aquatic area mitigation	$ 450.00	EACH	5.00	(10 hrs @ $45/hr)	$ 2,250.00
Monitoring, annual (by owner or consultant)					
Larger than 5,000 sq.ft. but < 1 acre with wetland or aquatic area impacts	$ 900.00	EACH	5.00	(10 hrs @ $90/hr)	$ 4,500.00
				TOTAL	**$ 6,750.00**

Total **$56,435.38**